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Metals Review

VOLUME XX •• No. 7 JULY 1947

WELDING AND CUTTING ISSUE

NOTABLE LECTURES

Reported This Month

Leon C. Bibber stresses the need for general knowledge of the many different welding processes in use today . . . Orville Barnett explains the "Lehigh System" for predicting the weldability of steels . . . Thomasson compares joining methods for thin metal on a cost basis . . . Biondi discusses factors to be considered in soldering and brazing . . . William J. Harris, Jr., cites development of aircraft armor as compromise between protection and weight, and Abraham Hurlich traces development of metallurgical inspection tests for armor . . . McElfish defines the metallurgist's job in an oil refinery . . . Claud L. Stevens illustrates function of metallurgical process control group at Ford Motor Co. . . . M. G. Fontana expounds a new theory of the passivation of stainless steel.

Featuring

Welding and Cutting

By R. D. Williams

Asst. Supervisor, Welding Research Div. Battelle Memorial Institute

An appraisal of recent developments in welding and allied fields as reflected in the technical literature. Based on the Review of Current Metal Literature.

Welding Equipment

150 new products and processes for arc, resistance and gas welding, cutting, brazing and soldering — welding machines, electrodes, welding alloys, hard facing materials, fixtures and positioners, accessories. A where-to-buy guide of new welding equipment developed during the past year.

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NEXT MONTH — INDUSTRIAL USES AND DESIGN

Metals Review

Vol. XX, No. 7

Published monthly by the American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio; Alfred L. Boegehold, President; Francis B. Foley, Vice-President; William H. Eisenman, Secretary; Harold K. Work, Treasurer; Arthur E. Focke, John E. Dorn, Walter E. Jominy, John Chipman, Trustees; Charles H. Herty, Jr., Past President. Subscriptions $5.00 per year ($6.00 foreign). Single copies $1.00. Entered as Second Class Matter, July 26, 1930, at the Post Office at Cleveland, Ohio, under the Act of March 3, 1879.

July 1947

RAY T. BAYLESS, Publishing Director MARJORIE R. HYSLOP, Editor GEORGE H. LOUGHNER, Production Manager

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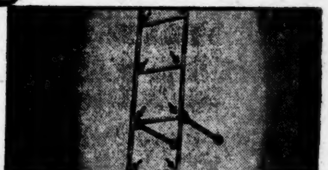

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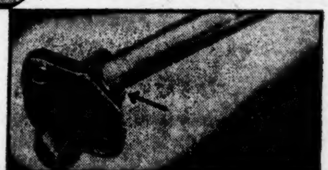

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Welding and Cutting

Eighteen Months' Progress as Reflected in the Technical Literature

By R. D. Williams
Assistant Supervisor, Welding Research Division
Battelle Memorial Institute

WELDING and cutting are entering expanded fields as a result of improvements in equipment and new applications stimulated by war-production needs. The war records of shipyards verified the importance of welding and cutting in quantity production; in fact, about 90% of the coated metal-arc welding electrodes produced during the war went into ship construction. Many improvements in design and practice, especially the use of prefabricated units (22-97, March 1946),* are already being applied in the construction of superior ships for postwar freight and passenger service.

Similarly in the fabrication of aircraft: Resistance welding processes using higher capacity equipment increased production of resistance welded parts by 30% (22-361, Sept. 1946), and development of highly accurate controls (22-465, Nov. 1946) also greatly enlarged the range of products which could be welded. Likewise, pressure gas welding, used for a number of years on railroad rails and pipe lines (22-416, Oct. 1946), was further developed during the war for heavy sections of alloy steel aircraft landing gears (22-689, 1945 volume).

The demand for high-quality welds in light-alloy aircraft parts led to the introduction of the inert-gas shielded-arc process, which involves an arc between the work and a tungsten electrode around which an atmosphere of helium or argon is forced (22-242, June 1946; 22-534, Dec. 1946). Although the process was introduced primarily for welding relatively thin aircraft parts, it has considerable promise for joining fairly thick sections of aluminum and magnesium alloys, and for production welding of stainless steel parts.

Although the railroads have been somewhat slower in adopting welding for the construction of new equipment than the other transportation industries, its use has been increasing (22-555, Dec. 1946). Numerous examples of maintenance welding and cutting applications, ranging from repair of rails to rebuilding of damaged rolling stock, are set forth by Stout (22-559, Jan. 1947).

*Literature references are designated by the corresponding item number in the Review of Current Metal Literature rather than by repeating the entire title, author and source; the reader can get this information by referring to *Metals Review* for the month indicated. "1945 volume" refers to Volume II, 1945, of the Review of Metal Literature, assembled and bound from the monthly installments.

Brazing also (long known as a repair process) is becoming an important fabricating process for major assemblies. Giroux (22-37, Feb. 1947) describes brazing of an automobile cylinder block from 120 parts, employing special jigs and accurately controlled furnaces.

In all these processes, the value of positioning the weldments has become increasingly evident, and positioners capable of handling very heavy assemblies have been developed (22-364, Sept. 1946).

Many possible applications of welding and cutting are still being restricted by obsolete codes and specifications, and although these are gradually being modified, more action is needed before the many advantages of welding can be fully realized (22-590, Jan. 1947).

Welding Processes

Arc Welding—The outstanding developments in this field have consisted of refinements in existing electrodes and equipment, as a result both of production experience and research. These include use of the lime-coated ferritic electrodes (originally developed for armor welding) for welding of high-carbon and cast steels, cast iron, and enameling steels (22-382, Sept. 1946); utilization of firecracker welding for actual production (22-479, Nov. 1946); development of an electrode for contact arc welding (22-324, Aug. 1946); and improvements in electrodes for underwater welding (22-18, Feb. 1946).

An interesting special use of arc welding is in salvaging sunken vessels and fabricating certain types of industrial installations by underwater welding (22-660, 1945 volume; 22-542, Dec. 1946). Use of automatic welding, such as the submerged-melt method, not only speeds up production, as was demonstrated by fabrication of equipment for making the atom bomb (22-7, Feb. 1946), but also permits welding of many of the corrosion-resistant materials (22-95, March 1947), and the fabrication of sections up to 6 in. thick, which would be impractical by manual processes (22-96, March 1946).

Numerous automatic and semiautomatic processes were introduced in Germany during the war, including "firecracker" welding and a method resembling an automatic "multi-arc" procedure in which a triple arc is formed between two electrodes and the workpiece, but few were developed to a point of practical application; in fact, German industry was greatly hampered by lack of competent welding engineers (22-215, June 1946; 22-82, March 1946). Miniature German arc welding appliances capable of welding wires in precision instruments as fine as 0.02 in. in diameter were said to make more efficient joints than soldering (22-511, Dec. 1946).

Automatic stud welding of both ferrous and nonferrous materials is speeding the construction of such widely varied parts as furnace linings and ship decks (22-304, Aug. 1946; 22-414, Oct. 1946; 22-548, Dec. 1946), while the development for aircraft of the inert-gas shielded-arc process was cited in the third paragraph (column 1). Hogg (22-510, Dec. 1946) and Dever (22-259, July 1946) discuss both manual and automatic atomic-hydrogen welding, and Wassell (22-578, Jan. 1947) the inert-gas processes.

Resistance Welding—The high heat inputs and short welding periods associated with spot, seam, and flash welding are particularly desirable where buckling and softening by welding heat need to be kept at a minimum. Two interesting uses are the spot welding of elbows in the gas ducts of jet engines (22-23, Feb. 1947) and the flash welding of turbine bucket wheels for jet engines to their shafts (22-120, April 1946).

Flash welding of aluminum using the standard machines for welding steel is impracticable, but Watson and Hipperson (22-366, Sept. 1946) describe a special machine with a fast-moving head for this purpose. By suitable modifications in welding conditions all of the newer high-strength aluminum alloys may be spot welded satisfactorily (22-429, Oct. 1946); Hess, Wyant, and Averbach have shown that Alclad 24S-T sheets, differing in thickness by ratios as high as 1:3, may be successfully welded by the selection of proper contours for each of the electrodes (22-54, March 1946).

Ductile high-strength flash welded joints in high-carbon, hard drawn steel wire are produced by postheating in the dies to induce direct transformation of austenite to pearlite (22-529, Dec. 1946). Spot welding schedules to produce good single-impulse welds in low-carbon steel plates up to ½ in. thick are presented by Heuschkel (22-532, Dec. 1946).

The most outstanding advance in resistance welding equipment is the development of storage-battery-powered machines (22-410 and 22-389, Oct. 1946) which permit greater adaptabil-

ity, coupled with lower power demands, than either of the two conventional "stored energy" types of machines. Flash welding circuits employing series capacitors (used for some years, chiefly in spot welding aluminum) (22-506) promise a lower kva. demand than present equipment (22-506, Dec. 1946).

Pressure gas welding of carbon steel rails and pipe lines has been successfully carried out for several years, but under the stress of war production, the economic and metallurgical advantages of the method were applied to the welding of alloy steel parts as well. Refinements in the process which permitted this application are due in no small part to the extensive production research conducted at the Menasco Manufacturing Co. Proctor (22-126, April 1946) describes the equipment used in the manufacture of alloy steel aircraft structures and the economic advantages of the process, while Fine, Maak, and Ozanick (22-99, March 1946; 22-144, April 1946) describe some of the metallurgical aspects of the joints which are formed below the fusion temperature. A study of a number of the variables affecting the joint quality has also been made (22-210, May 1946; 22-523, Dec. 1946). Applications of the process now include the welding of quite thick sections of stainless steel (22-34, Feb. 1947), and a number of chromium, nickel, and copper alloys (22-569, Jan. 1947), although some of these materials require such careful production control that the economic advantages are not yet too certain.

Aluminum has also been pressure welded with both butt and lap joints (22-19, Feb. 1946; 22-296, July 1946), while heated dies are used in Germany to make lap welds in thin aluminum sheet (22-332, Aug. 1946).

The conventional pressure gas welding process involves the heating of a closed joint under pressure until solid-phase bonding occurs. Tests on joints made with an open-butt, pressure gas welding process (22-123, April 1947) suggest that it may have certain advantages, in particular a lower unit heating time and reduction in the required quality of end preparation of the pieces to be joined.

Gas Welding—The use of gas fusion welding, principally oxy-acetylene, has declined in recent years with the development of other generally more efficient processes. However, use of multiple-tip torches has enabled the oxy-acetylene process to compete with others in the welding of stainless steel sheet (22-300, July 1946), and a German deep fillet technique for steel up to about ½ in. thick saves time, gas, and welding wire as compared with conventional gas welding (22-52, Feb. 1947). Also, the high degree of control of the molten pool still makes it useful for certain special applications. For example, an oxy-acetylene root pass in an otherwise arc welded joint eliminates the need for backing rings in thick-walled pipe lines (22-618, 1945 volume).

Thermit welding has been known for many years, and while it is used in the production of certain thick-section parts, other welding processes have seriously encroached upon its applications. However, it is becoming increasingly useful in repair of machinery which cannot be readily replaced, such as in steel plant maintenance (22-461, Nov. 1946).

Materials

Steel—Even the low-carbon and low-alloy steels—probably the most readily weldable of all the common materials—have unexpected limitations. Hoyt demonstrates (22-49, March 1946) in the words of Gilbert and Sullivan, that "things aren't always what they seem", and that frequently a supposedly weldable steel can become, through not unusual circumstances, definitely unweldable, even though it conforms to specifications for the particular application.

Cast Iron—Although welding of cast iron is largely limited to salvage, primarily by the oxy-acetylene process, special techniques have been developed which permit utilization of the higher, more localized heat input of the metal arc (22-306, Aug. 1946). Nickel-base electrodes for arc welding cast iron have appeared on the market, and have proved useful not only in repairing of parts subjected to heat and friction, but also in fabricating assemblies of steel and cast iron.

High speed and surface hardened steels are not among the easily welded materials because of the deleterious effects—both hardening and softening—produced by the welding heat. However, Howat (22-48, Feb. 1947) shows that with suitable preheat and post-heat, tips may be arc welded onto high speed steel to produce cutting tools superior to those made entirely of high speed steel, and Llewellyn (22-149, April 1946) describes the successful gas, arc, and resistance welding of nitralloy steels.

Light alloys of aluminum and magnesium, which were welded only to a limited extent prior to the war, are now being welded on a production basis. Some of the present and possible future methods are given in a British symposium (22-562, Jan. 1947). The new and highly satisfactory inert-gas shielded-arc process for welding these alloys has already been mentioned, as has pressure welding, by means of heated dies (22-19, Feb. 1946). Tylecote (22-150, April 1946) reviews the current status of spot welding of magnesium and points out the methods of overcoming its chief drawback—namely, a highly tenacious oxide film.

The commercial advantages of flash welding aluminum alloys are discussed by Close (22-154, April 1946), while the need for additional investigation to develop satisfactory arc welding methods for the new high-strength aluminum alloys is presented by Apblett (22-575, Jan. 1947).

Lead—Another useful material long welded by the gas process (22-365, Sept. 1946) has recently been spot welded successfully. Heuschkel (22-676, 1945 volume) suggests that this method will prove of considerable value in the assembly of lead-lined chemical containers, as well as in the production of lead-covered steel and terne plate.

Hard Facing—New alloys and new applications for hard facing are continually appearing, and selection of the correct material will lead to improvement in many products (22-102, March 1946). Metal spraying has recently been used to good advantage (22-425, Oct. 1946), particularly in hard facing aluminum parts with stainless steel, monel, nickel, and bronze (22-212, May 1946).

Brazing

Brazing, though used for centuries, has only recently changed from a relatively slow manual process to a quantity production process (22-87, March 1946). This has been brought about by numerous fundamental studies such as Rhyne's report on factors controlling the strength of brazed joints in S.A.E. 4130 and 1010 steels (22-352, Sept. 1946), Miller's study of metal flow and fillet formation in the brazing of aluminum (22-140, April 1946), and a study by North American Aviation investigators of the flow of silver brazing alloy in steel joints (22-185, May 1946).

In addition to improvements in control of time, temperature, and atmospheres in conventional furnaces for production brazing, the recent application of radio frequency (22-87, March 1947) permits highly localized brazing, which eliminates undesirable thermal effects in other parts of an assembly. A novel method of introducing copper and silver furnace-brazing alloys by metal spraying is said to produce acceptable joints, increase production and save man-hours of labor (22-168, May 1946).

Soldering

A process as old as brazing and closely related to it, soldering has also been improved by a more complete understanding of the conditions required for optimum performance. Soft soldering becomes a useful production process when engineered, as shown in a discussion of the metallurgical properties of solders and the theory of soldering (22-156, April 1946); special soldering irons and high-frequency batch-heating equipment are also described. Soldering of radiators in large, automatically timed, induction heating units increased production rate 180% (22-558, Dec. 1946).

A cored-wire solder (22-316, Aug. 1946), in which the flux is held by four equally spaced channels around its periphery, insures that the flux liquefies before the solder, which causes a steady flow of flux to the surface to be soldered, and consequently a sound joint without flux voids.

Although aluminum solders are so relatively new that little technical in-

formation is yet available, they are reported to show considerable promise where low-temperature bonding of aluminum is desirable. As with other solders, strength of the joints is generally lower than for welded joints, and they are not satisfactory where exposure to corrosive conditions is expected.

Cutting

Several new processes, combined with refinements in the control of automatic cutting machines, have greatly widened the scope of oxygen cutting and gouging of steel in production and salvaging operations. While underwater cutting for the salvage and repair of naval vessels has been known for several decades, an intensive investigation of the arc-oxygen process (22-627, 1945 volume) resulted in the development of covered steel and ceramic tubes as electrodes, which permit many times the speed of the older carbon-electrode process, lower power requirements and simplified techniques; performance is equal to that obtainable with oxy-acetylene in air. The ceramic electrodes not only lasted 12 times as long as coated steel electrodes, and cut thin and medium thick steel plates faster, but also proved useful in cutting nonferrous metals, cast iron, and stainless steel.

Manual cutting of cast iron, long considered almost impossible, is now a successful and economical procedure, and castings many inches thick can be cut (22-344, Sept. 1946). A new process (22-89, March 1947), designed primarily for cutting stainless steel but applicable to cast iron, involves the injection of an iron-rich powder into the stream of cutting oxygen. This powder, heated to ignition by the oxyacetylene preheat flame, burns in the oxygen stream creating a high-temperature reaction which removes the refractory oxides produced by a combination of melting and fluxing. The process may be used manually, but has been found particularly useful in production cutting of stainless steel parts to tolerances approaching those obtained in oxy-acetylene cutting of carbon steels.

Another method of cutting stainless steel (22-322, Aug. 1946) also involves the injection of powder into the oxygen stream; this powder is a flux which removes the chromium oxides, producing clean, smooth cuts economically. Cutting speeds for 3 and 4-in. thick sections or stacks of sheets equal those for mild steel. In still another process for the rapid cutting and piercing of stainless steel (22-551, Dec. 1946), the preheat is supplied by an electric arc, and the oxygen is introduced through a tubular mild-steel electrode. Although limited to manual operation, this process has proved very effective in the fabrication of complicated assemblies requiring holes of various shapes, because the portability of the equipment allows piercing and cutting in any position.

The advantages of automatic machine gas cutting of carbon steels are already well known, and it has a wide range of applications in modern metal production and fabricating industries (22-195, May 1946). Precision has been increased by two recently developed tracing mechanisms. In one device (22-98, March 1947), a magnetic tracing head holds the tracing rollers to the templet by a magnetic force of 35 to 40 lb.; cuts can be made to a tolerance of 0.01 in. The other device (22-34, Feb. 1946) embodies an electronic tracing head which follows silhouettes or simple line drawings in cutting complex steel shapes to close tolerances.

Robert D. Williams is one of the younger active workers in welding technology. He is a member of the supervisory staff of the welding research division of Battelle Institute and is a frequent contributor to welding literature. A graduate of Harvard University, Mr. Williams also holds a Master of Science degree from Massachusetts Institute of Technology. Prior to joining the Battelle staff in 1942, he taught welding engineering and heat treatment for five years at the University of Illinois.

Research

Many production and fundamental research investigations are currently under way, a noteworthy example already mentioned being the research on resistance welding conducted by Hess and his associates at Rensselaer Polytechnic Institute. Fusion welding, however, particularly metal-arc welding, is still used far more than the other welding processes so that a great deal of present-day research is being directed toward this method (possibly because there is less precise control in fusion welding than in resistance welding). The underlying factors in the metal-arc welding process, the weldability of the materials fabricated by the process, and stresses in the resulting structures are among the important phases now under investigation.

Fundamental research on the electrophysics of the arc has been in progress for some time, although there is a great deal of work still to be done. Among the factors listed for further investigation (22-543, Dec. 1946) are the study of metal transfer across the arc, and the effect of the electrical and chemical conditions existing during this transfer on the deposited metal.

Hydrogen has been recognized as a bad actor in both weld and base metal, frequently causing cracking during the welding operation, and justifiably suspected of weakening welded joints so that they will fail at lower loads, even when cracking does not occur. Since hydrogen in the weld metal is believed be be caused primarily by hydrogen-forming compounds in electrode coatings, attempts have been made to determine the atmospheres produced in metal-arc welding, and the effects on the welds of the individual components of these atmospheres. A recent investigation (22-358, Sept. 1946; 22-572 Jan. 1947) revealed the principal gases existing in arc atmospheres of different types of coated electrodes, and postulated a theory on the reactions involved in the production of these gases. The relative harmfulness of the gases was determined by means of synthetic atmospheres in which the relative proportions of the gases could be varied.

The fundamental mechanisms of absorption of hydrogen by the weld metal, its diffusion into base metal, and its subsequent liberation (caused by structural, mechanical, and thermal changes in the metal), and consequent embrittling action have been studied. Rollason and Mance (22-673, 1945 volume) explain the vacuum fusion and vacuum heating methods for determining the hydrogen content of weld metals, and Herres (22-533, Dec. 1946) reviews the steel metallurgy involved, considering the effects of various reactions in controlling porosity, and correlating the degree of embrittlement with microstructure and rate and temperature of straining. Methods for determining the specific effects of hydrogen on welds made with different electrodes and procedures are also discussed.

The knowledge obtained by such investigations was turned to immediate use in the development of low-hydrogen-producing coatings for ferritic electrodes to be used in welding high-strength steels and armor. Tests made with ferritic electrodes having both the low-hydrogen and ordinary high-tensile coatings on base metals whose yield strengths range from 90,000 to 150,000 psi. indicate an appreciable superiority of the welds made with the low-hydrogen type (22-528, Dec. 1946).

Many other factors besides hydrogen may also influence weldability and weld cracking. Among them are internal stresses, effects of welding heat on structures, chemical composition of the steels (especially sulphur content), weld porosity, and oxide inclusions (22-469, Nov. 1946).

The relationship of several of these factors to cracking in stainless steel welds is presented by Thomas (22-453, Oct. 1946), who relates the percentages of nickel, chromium, and molybdenum in the weld metal to the amount of ferrite which can be expected, and suggests in turn that the ferrite is a deterrent to crack formation. He also describes the cracking effects of several trace elements such as carbon, sulphur, and phosphorus, but points out that these are kept well below the dangerous limits in stainless steel welds.

Another interesting weldability study was conducted by Keyser and Lorig (22-524, Dec. 1946) on a group of low-alloy steels in which copper was used instead of carbon to give the required strength combined with superior weldability. Results indicate that copper-

bearing steels, of the same tensile properties as the control carbon steels, have superior notched-bar toughness and develop lower hardness in the weld zone; they should therefore be more resistant to welding cracks.

Effect of welding on Navy high-tensile, low-alloy steels (22-527, Dec. 1946) was studied by Charpy notched-bar tests and a recently developed nick-bend test (more accurately called a notched-bead bend test). Welding had an adverse effect on several of these steels by raising the temperature at which the transition from ductile to cleavage fracture occurred.

Welding metallurgists have long sought for a universal weldability test, but the longer the search continues and the greater the knowledge of the factors affecting weldability, the more remote becomes the possibility of attaining the desired goal. During the search, however, many excellent weldability tests have been developed, including direct measurement tests such as tensile, various bend tests, and the clip test; cracking tests, both underbead and weld-cracking; and indirect tests, involving the relationship of microstructure, hardness, and dilatation behavior to weldability (22-357, Sept. 1946).

In the notched-bead bend test mentioned above, a bead is deposited on a plate, notched lengthwise with a hack saw and the plate bent with the grooved notch in transverse tension. This test in its original form was satisfactory for shop use, but the more exacting requirements of the testing laboratory necessitate control of the groove contour by careful machining, and proper allowance for the effects of plate thickness and the time between welding and testing (22-138, April 1946). With these factors under control, the test promises to become a very useful one.

The undesirable effects of welding stresses may be completely eliminated in small weldments by suitable heat treatment of the entire piece. In large structures, however, although local heat treatment has sometimes been helpful, the problem has had to be tackled from the point of view of control of stresses rather than their elimination. The swing from riveted to welded ship construction led to many investigations. One of the major problems was to minimize the stresses by welding sequence. Studies of the magnitude of stresses occurring at various locations in a ship's hull (22-570, Jan. 1947) were made on test plates, ship models, and actual naval vessels, and good correlation of results was found. Both tensile and compressive stresses at times exceeded 10,000 psi., but welding sequences could often be selected which reduced those stresses to a relatively low level.

Failures of welded ships in service also initiated a comprehensive program at the University of California. Residual stresses occurring at intersections of butt welds were studied (22-427, Oct. 1946), and it was found that although longitudinal stresses along the center line of the welds can reach a magnitude of 47,000 psi. for a considerable portion of the length, the stresses at weld intersections are no higher and are usually somewhat lower. Stress differences between welds made from end to end of a joint, and welds made from the middle of a joint outward are not significant.

Use of austenitic electrodes, block welding and other special techniques were also investigated in this program (22-447 and 22-448, Oct. 1946) and it was concluded that the relatively slight reduction in stresses obtained with austenitic electrodes did not justify their use. Longitudinal stresses could be kept below 35,000 psi. by use of a suitable block welding sequence and proper coding between the deposition of each block, although not all block procedures were beneficial. Welding with a cascade technique in which each pass extended from the root of the weld to its surface was found to produce somewhat lower longitudinal stresses than those developed by ordinary welding.

It should be borne in mind that other factors besides stress have contributed to ship failures. Possibly the greatest single factor (other than design) has been the improper specification of the steel. Brittleness at the lower temperatures encountered in service is among the factors to be considered in selection of the steel (22-49, March 1946). Faulty welding practices have also contributed to ship failures, and no less than 19 such practices are listed (22-644, 1945 volume), ranging from improper fitup to the use of metal slugs laid into the weld groove and bridged over with weld metal. Fortunately, both improper selection of steel and faulty welding practices can be corrected, so that along with proper control of stresses, the chief causes of ship failures can be eliminated.

It has long been accepted that welding heat effects are frequently undesirable, but although gold and silver can be welded at room temperature, the common metals still require heat for welding. That the end point in minimizing welding heat has not yet been reached is suggested by some fundamental experiments (22-53, Feb. 1947) in which copper and nickel were welded in a vacuum at room temperature by pressure produced when a pointed specimen was dropped onto a flat specimen. While many of the theories concerning solid-phase bonding at low temperatures do not appear to be immediately applicable to practical welding procedures, further knowledge of some of the phenomena described may well lead to outstanding advances in the science of welding.

While excellent electrode coatings have been developed in the past two decades largely by trial and error methods (perhaps because of the lack of fundamental knowledge of the behavior of the arc, or perhaps because of the pressure of industrial competition), recent work has been conducted with the objective of determining some of the fundamental properties of the principal ingredients of these coatings. Vickery (22-497, Nov. 1946) describes the higher temperature reactions of FeO, MnO, TiO_2, and SiO_2, and the mineral constitution of the resulting slags; the results of these tests combined with a knowledge of the physical properties of the constituents involved may permit a more scientific approach to manufacture of coated electrodes.

Recent Applications of Welding

One of the great advantages of welding as an assembly method is its speed —an advantage nowhere more clearly demonstrated than in the tremendous number of welded products used during World War II. Outstanding among many examples of almost miraculous production achievements is the assembly of the Mulberry Pierheads. Thirteen of these floating loading docks which made D-day possible were produced within nine months of the time that their future need became apparent, despite the fact that a shipyard had to be first established for their construction (22-457, Nov. 1946). Another achievement was "Operation Pluto" (22-174, May 1946) in which 975 miles of 3-in. pipe in 20 and 40-ft. lengths were flash welded together to form oil pipe lines extending under the English Channel to the invasion ports.

Transition from riveting to welding in heavy British combat tanks is traced by Fowler and Denaro (22-468, Nov. 1946; 22-541, Dec. 1946), starting with the early welding of relatively light sections with austenitic electrodes and progressing to the assembly of heavy sections with mineral coated ferritic electrodes.

On the other side of the military picture, light-weight sectional structures, which could be carried by small groups of men as well as by airplanes, employed tubular steel parts so welded as to give a minimum of warpage (22-107, March 1946).

In the production of jet engines—as important today for commercial airplanes as during the war for military—a number of welding processes are used, ranging from flash welding of turbine-wheel shaft assemblies to arc welding the turbine wheels themselves. Special techniques have been developed for the stainless steels and high-temperature alloys; for example, rotors are assembled with over-all distortion of only 0.0025 in. (22-197, May 1946). Although rotors have fairly heavy sections, many jet-engine parts such as exhaust stacks, discharge nozzles, and inner liners are formed from sheet metal and joined by spot and seam welding, atomic-hydrogen welding, and even, in sections where the operating temperatures are low, by silver soldering and brazing (22-351, Sept. 1946; 22-405, Oct. 1945). Close tolerances are maintained even in materials prone to distortion (22-221, June 1946).

While there is no doubt that welding will be used extensively in future ship construction, Adam and Lillicrap (22-467, Nov. 1946) point out that this will come about in Britain at least only

(Turn to page 47)

Welding Equipment

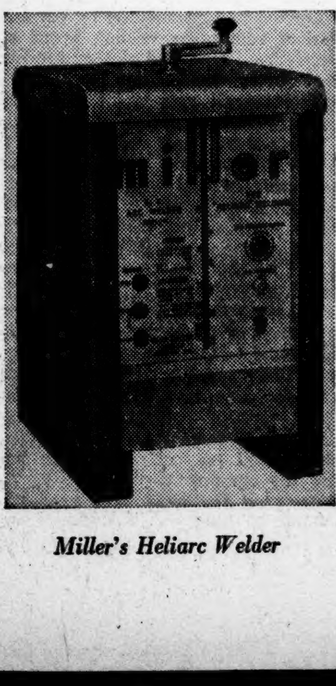
150 New Products and Processes as Described by the Manufacturers

REFINEMENTS in welding and cutting techniques and the tremendous war-broadened field of applications have called for corresponding refinements in equipment. Numerous examples of manufacturers' developments can be found in equipment for inert-gas shielded-arc welding; in storage-battery-powered resistance welders, heavy-duty multiple-spot welders, flash welders for aluminum; in improved electrodes and coatings such as lime-ferritic types to minimize underbead cracking, and nickel-cored electrodes for welding cast iron; in cutting equipment using powder or flux-injection methods and the arc-oxygen process; in improved brazing alloys and cored wire solders.

Arc Welding

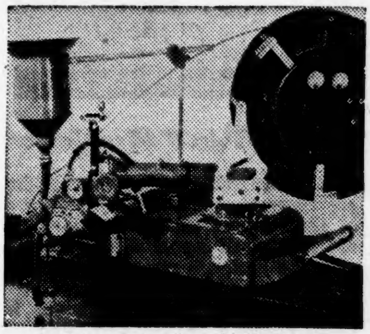
Gas-shielded arc welding may be typified by General Electric's recently developed Inert-Arc process (R-676)*. A single electrode, usually of tungsten, is held in an electrode holder which projects a smooth, low-velocity stream of helium or argon gas around the electrode and arc. No flux is needed. Both a.c. and d.c. arcs can be used, with d.c. preferable for stainless steel, copper, thin mild steel and special metals such as fernico; a.c. is used for magnesium, aluminum and beryllium copper.

*Further information about the products described may be secured by using the Reader Service Coupon on page 53, specifying the appropriate R-number, or by writing direct to the manufacturer at the address given on page 19 or 21.



Miller's Heliarc Welder

The largest field for this type of welding is in aluminum fabrication, and Aluminum Co. of America has developed a portable unit that generates an a.c. arc in an envelope of argon gas (R-677). A three-wheeled base carries the welding transformer, cylinders of argon gas and connections for the water and drain lines. The reel contains 75 ft. of hose for a wide radius of welding.



Portable Unionmelt Welder

Linde Air Products Co. calls the process Heliarc welding, and has brought out a new water-cooled Heliarc torch known as HW-4 (R-678) with an adjustable tungsten electrode and a ceramic cup to direct the shielding gas to the weld area. A new series of a.c. welders of heavy construction, especially designed for use with the Heliarc torch, has been announced by Miller Electric Co. (R-679). They incorporate adjustable high-frequency current and high-duty cycle ratings, along with a variable control.

Accurate control of the expensive helium and argon gases used for inert-gas welding is provided by the Victrometer, a flowmeter made by Victor Equipment Co. (R-680). It has graduations for both helium and argon and is furnished with calibrations for hydrogen. A built-in needle valve and single control wheel maintain uniform fractional flow adjustment.

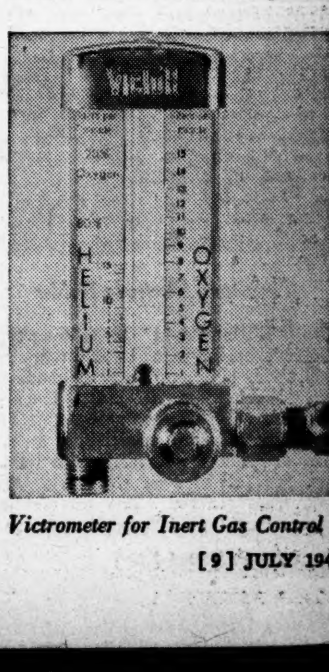
For submerged melt welding (an automatic process for welding electrically beneath a layer of granular flux) Linde has developed a new portable Unionmelt welding machine known as the DS-37 (R-681). The machine weighs only 190 lb., and can be placed directly on the work and hand-guided, or it can be mounted on standard track or guided by a small structural angle clamped to the work. The welding head can be swung forward through 45°, tilted at any desired angle to either side, or positioned anywhere in a circle around the carriage. The DS-37 will butt weld, in a single pass, material from 16 gage to ¾ in. thick.

Lincoln Electric Co. also makes equipment for submerged melt welding, and has recently devised a water-cooled copper clamping fixture for use with its Lincolnweld automatic (R-682) in manufacturing links for hoist chains. The fixture holds the work and serves as a mold to retain the molten metal during welding. It is formed in two parts and is air controlled by a foot pedal.

Numerous new models of conventional arc welding machines have been designed to save weight and space, and simplify welding operations. General Electric's single-operator high-speed direct current machine, Type WD-40, is available in 200, 300 and 400-amp. models (R-683). Full arc voltage is generated instantly after short circuit, and a single-dial, dual-range control combines precision with the convenience of single-dial control, so that the operator can preset the correct current for any given job. (See illustration on page 10.)

Portable arc welders include Harnischfeger Corp.'s Model WN-200 (R-684), available as a stationary or trailer unit. It is rated at 200 amp., but has a service range of 30 to 260 amp. Both types have engine and welder mounted on a steel frame; the trailer model is carried on a running gear of standard track width, and is equipped with standard tires.

Hobart has a combination gasoline-



Victrometer for Inert Gas Control

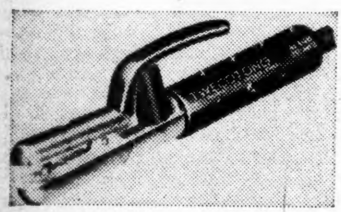
electric 300-amp. welder (R-685) that does the job regardless of power supply and may be placed on a portable mounting for use in the field. Another Hobart portable 300-amp. welder is diesel-driven (R-686), while two other models introduced during the past year are self-propelled—the Hobart "mobile" 300-amp. welder with automotive transmission connected directly to the welding generator (R-687), useful for maintenance welding around steel mills, oil refineries and industrial plants; and a railway welder in 300 and 400-amp. sizes (R-688). Hobart's newest line of industrial a.c. transformer welders (R-689) features an exceptionally large, illuminated, current-indicating scale; they are offered in 300 and 500-amp. sizes either stationary or mounted on a three-wheeled truck.

Lincoln Electric's latest Fleet-Arc a.c. welder (R-690) in 200, 300 and 500-amp. sizes is equipped with an arc booster which increases the current the instant the arc is struck, so that the arc is started automatically without the use of high-frequency devices or higher voltages. Lincoln's LAF-2 (R-691) is an improved automatic welding head that accommodates a 5/16-in. electrode. It is normally used in conjunction with a 1200-amp. automatic welder. A rheostat in the control box permits a current range of 300 to 1200 amp.

A twin-unit, outdoor a.c. welder is made by General Electric (R-692) in a single enclosure. Each of the two circuits can be used simultaneously and independently with electrodes up to 5/16 in. in diameter, or combined into one circuit for heavy welding with 3/8-in. electrodes.

Electrode Holders and Accessories

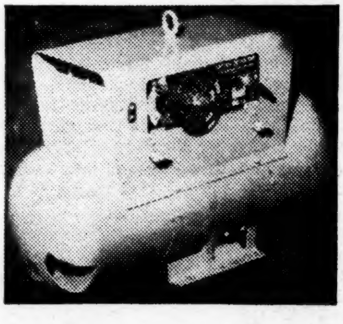
A new A-316 Twecotong electrode holder designed for 200-amp. welding equipment (R-693) is a smaller companion to Tweco Products Co.'s 300 and 500-amp. models. It gives a 95-lb. bite on a 5/16-in. electrode; insulation is molded laminated glass cloth bakelite.



Twecotong Electrode Holder

"Little David" is a tong-type electrode holder rated at 350 amp. for rods up to 1/4 in. in diameter made by Lacey-Webber Co. (R-694). Garibay 350, made by Garibay Mfg. Co. (R-695) with 300-amp. capacity, is an all-position holder provided with offset jaws for full view of the work. The Continental is the name of Welding Engineering Co.'s 300-amp. holder featuring adjustable contact tension for light and heavy electrodes (R-696).

The Twin Thermatorch (R-697) made by Plymouth Equipment & Supply Co. for carbon-arc welding accommodates three sizes of carbons—1/4, 5/16 and 3/8 in., with special provisions for larger carbons if necessary. Martin Wells Co.'s Rod Saver electrode holders have incorporated a simple design improvement that makes possible the use of silver brazed cable connections (R-698). A small copper disk is supplied with the holder, along with directions for the silver brazing.



G.E.'s D.C. Arc Welding Machine

The Lite-ning arc torch made by Cesco Products, Inc. (R-699), produces a carbon-arc flame characterized by soft, intense heat with no pressure blow or oxides. The arc is automatic, with instant adjustment maintained by thumb control.

An arc-starting powder (R-700) is recommended by Electrical Engineering Co. for applications where low open-circuit voltages and low current values are employed. It provides an artificial current-carrying path between the electrode and the work before the first molten droplet is transferred.

An arc welding compound which comes in the form of a paste that is thinned with water and brushed or sprayed into the seam is intended to stabilize and quiet the arc, improve fusion and prevent adhesion of weld spatter. It is called Pom and G. W. Smith & Sons is the manufacturer (R-701). After welding, spatter and compound are quickly wiped off with a dry cloth.

Resistance Welding

It is not surprising that the extensive investigations on spot welding currently under way have companion pieces in the development of widely varying types of welding machines. High-speed, automatic operation with increased production per machine-hour is provided by multiple-spot welding, paricularly in the assembly of sheet metal parts. A machine for this purpose developed by Progressive Welder Co. is known as the Progress-O-Matic (R-702). The various guns on this machine can simultaneously weld different thicknesses of metal, requiring variable welding times, heats and speeds. Individual guns are attached or removed with a single cap screw. An air-driven unit controls the sequences of pressure, timing, and amount of current. Progressive Welder also has developed battery-operated multiple-spot welders (R-703), which are able to perform a greater number of welds simultaneously without imposing high loads on power lines.

Another huge machine built by National Electric Welding Machines Co. (R-704) is installed at Pullman-Standard Car Mfg. Co. for welding stiffeners to the interior of car sides. Work travels on a table 30 ft. long and 10 ft. wide beneath a battery of 48 stationary electrodes; electric eye control makes the operation entirely automatic. Thomson Electric Welder Co. has devised a new Ultra Speed spot welder (R-705) for welding wire mesh. One model has 25 electrodes arranged to weld up to 25 longitudinal wires spaced as desired across a maximum width of 48 in.

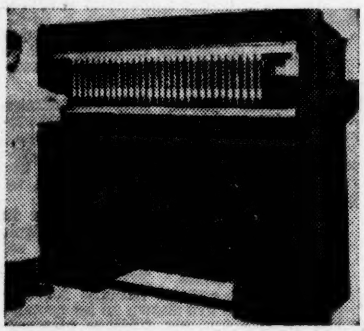
A giant single-spot welder made by Sciaky Bros. (R-706) is able to weld three thicknesses of 1/2-in. structural steel without removing rust and scale. Welding sequence is *(a)* preweld period of high pressure and low current to eliminate surface oxides, *(b)* high-current, lower pressure welding period, and *(c)* postweld period in which current is interrupted under high pressure for a final forging action.

Press-type spot and projection welders are being built with versatility as an important feature. Progressive Welder's new line (R-707) is designed for high-speed continuous operation as well as job lots, with rapid changeover in arrangement of knees, welding arms, platens and electrode holders. It can be used for pulsation welding, resistance upsetting and resistance brazing, preheating, postheating or tempering. Taylor-Winfield's Style 1 welder (R-708) is primarily a projection welder built with upper and lower T-slotted platens for dies, but may be converted to spot welding by the addition of removable welding horns and electrodes. A second similar air-operated press welder is the Style 4 equipped with spot welding electrode holders.

Other new press welders are the AVA (air vertical action) spot and projection welder built by Precision Welder and Machine Co., that looks like a machine tool (R-709), and Federal Machine and Welder Co.'s Taylor-Hall line that features a "true pressure" principle (R-710), with welding pressure applied in a straight vertical movement of the upper electrode. Do-All Co. (R-711) is now marketing a new 10-kva. Taylor-Hall spot welder. This machine also has vertical-plane "true pressure" action, and has an automatic electronic timing device (Raytheon) and magnetic contactor built into the equipment.

Designed for continuous production welding of thin metals, Weldex, Inc. (R-712), has added two series of high-

speed, automatic, air-operated, electronically timed spot welders—Model 752-P, press-action type, and Model 752-R, rocker-arm type. Thomson Electric Welder Co. has a new series of rocker-arm spot welders (R-713) described in the April issue of *Metals Review*, page 55, and Pier Equipment Mfg. Co. has announced its A-200 rocker-arm spot welders (R-714), air-operated with foot switch control. Optional horn length and five heat con-



Progress-O-Matic Multi-Spot Welder

trols are features of a 20-kva. foot-operated unit made by Larkin Lectro Products Co. (R-715), and Progressive Welder also has an improved line of 30, 50 and 75-kva. pedestal-type welding machines (R-716).

New bench-type spot welders for small parts include a 15-kva. motor-driven Model A-11 (R-717) made by Thomson Electric Welding Co.; and an air-core transformer stored-energy welder operating from 110-volt, 60-cycle, a.c. power supply at speeds ranging from 30 to 180 spots per min. made by Vangtronic Corp. (R-718). Two 1-kva. bench welders are the Rex Junior (R-719), made by Rex Welder & Engineering Co. with capacity for welding two sheets of 24-gage cold rolled stock; and a foot-operated 46-lb. welder with a maximum stroke of 1 in. and a throat depth of 3¼ in. made by Banner Products Co. (R-720). Raytheon Mfg. Co. incorporates a capacitor-type energy storage system with a maximum storage energy level of 225 watt-seconds in a precision spot welder for light-gage sheet metal and wire (R-721).*

A portable gun welder of rocker-arm type is offered by Eisler Engineering Co. (R-722) with a kva. rating from 30 to 75, and Progressive Welder Co. has introduced traveling gun welders that fall midway between portable guns and stationary machines and are useful where work is relatively large and quite a few welds are required, yet quantities are not large enough to warrant use of high-production multiple-spot welders (R-723).

Two new flash welders may be cited as typical of improved equipment for flash welding of aluminum, as well as steel. One is Sciaky's line ranging in size from 75 to 500 kva. (R-724); the smallest will weld mild steel cross sections up to 0.90 sq.in., the largest up to 5 sq.in. Heavy duty machines are equipped with synchronous timing control, postheat current and phase-shift heat control for use on aluminum, high-carbon and aircraft steels. Typical of Progressive Welder's storage-battery-powered flash welders is an R.W.M.A. Size 3 cam-operated machine (R-725). The 16-cell 8-volt water-cooled battery power pack is in the center, with the battery charger and control assembly on one side and the welding unit on the other.

"Butt-on Spot" is the name of an attachment that converts spot welders to butt welders for wires or thin-gage sheet metal. It is made by Robert W. Hoffman Co. (R-726). Three series of bench-type butt welders have been introduced by Universal Welder Corp., Banner Products Co., and Rex Welder & Engineering Co. Universal's is a line of hand and air-operated Midget welders available in 10 and 20 kva. for wire products and small steel molding strip (R-727); Banner Products has a 10-kva. unit with eight ranges of heat (R-728); and the Rex welder operates from a 110-volt source on mild steel wire or rods up to 1/16-in. diameter (R-729).

Timers, Controls and Accessories

An electronic timer for all general-purpose spot welders over a range of 3 to 120 cycles is applicable to manual, air or motor-operated welders. Designated as Type 30CR3 by its manufacturer, Photoswitch, Inc. (R-730), it may be used with either 115 or 230-volt a.c. supply and has an accuracy variation of less than 2%. A very small welding timer made by Metron Instrument Co. (R-731) employs just one tube and two relays with a control box measuring only 4x4x2 in.; timing intervals from 1/60 sec. up to several minutes can be obtained. Square D Co. has designed a timer for gun welders known as Class 9052, Type FG (R-732). In addition to squeeze time, weld interval, hold time and off time, it provides a fifth period called "squeeze delay" which makes squeeze times for the first and succeeding welds independently adjustable.

Weldex High-Speed Spot Welder

General Electric has redesigned its line of sequence and sequence-weld timers (R-733) by including an improved circuit for consistent high-production welding speed, and has also announced a new phase-shift heat control accessory (R-734) for use with ignitron contactors or nonsynchronous control combinations when the power supply is 230 or 460 volts.

Square D has a new line of electronic contactors using ignitron tubes (R-735) designed for high-speed resistance welding jobs, and also a new combination control unit known as Class 8992 (R-736) that has both contactor and sequence timer in a single enclosure arranged to mount on the right-hand side of the machine. Weltronic's timer contactor (R-737) is only 8½ in. wide and uses only two relays, while Electronic Products Co. (R-738) has two new models—Series A, suited for short-time operations of 45 cycles or less on loads up to 1 kva.; and Series B, which has a time control ranging from ½ to 45 cycles and an electronic contactor capable of handling loads up to 15 kva.

A line of synchronous precision controls recently introduced by General Electric Co. (R-739) includes in one enclosure ignitron contactors, a weld timer, electronic heat control, and (as optional equipment) sequence controls and tempering control. Westinghouse's Weld-O-Timer (R-740) for nonsynchronous resistance welding control permits hundreds of combinations for sequencing and timing from only four factory-wired subassemblies and two supplementary subassemblies.

A water-cooled ejector-type electrode holder for resistance welding machines offered by Weiger Weed and Co. (R-741) is equipped with a hard alloy taper socket of high electrical conductivity and a stainless steel ejector tube and knockout plug with a double bearing support and spring action. It may be adjusted in three positions of 15, 30 and 45° from the vertical.

Ampco Metal, Inc., has improved its design of straight water-cooled holders and has introduced a variety of new spot welder tips (R-742), including radius-faced tips, replaceable tips faced with refractory metal, gun-type tips and irregular tips. Special copper-base alloys known as K-B Alloy No. 10 and No. 12 are used in a new line of K-B Sealtite resistance welding tips made by Keaton Mfg. Co. (R-743). High hardness and electrical conductivity contribute to long tip life, and scientifically correct water holes and accurate Morse tapers provide quick cooling

(Turn to page 14)

*See end of article, page 19, for brief note about Federal Machine and Welder Co.'s new bench-type combination spot and projection welder.

A.S.M. Review of Current Metal Literature

An Annotated Survey of Engineering, Scientific and Industrial Journals and Books Here and Abroad, Received in the Library of Battelle Memorial Institute, Columbus, Ohio, During the Past Month.

1 ORES & RAW MATERIALS Production; Beneficiation

1-64. Beneficiation of Western Beryl Ores. H. D. Snedden and H. L. Gibbs. *Bureau of Mines Report of Investigations 4071*, May 1947, 18 p.

Procedures for preparing commercial-grade concentrates of beryl from pegmatite ores. The ores that were beneficiated ranged from 0.94% BeO to only 0.08% BeO; they were from different localities and varied in physical character, indicating that the procedures are flexible and probably adaptable to other ores. Techniques used were grinding, sink-and-float-separation, tabling, and flotation. Also a reliable method for the determination of beryllium in the ores.

1-65. The Saga of Red Mountain Iron. A. A. Nilsen and Roy Yingling. *Mining Congress Journal*, v. 33, May 1947, p. 28-33.

Mining and ore beneficiation practice of Tennessee Coal, Iron and Railroad Co. near Birmingham, Ala.

1-66. Production of Alumina by the Lime Soda Process. Part IV. W. E. Prytherch, M. L. R. Harkness, and W. D. Spencer. *Chemical Age*, v. 56, May 10, 1947, p. 607-613.

Results of British work on the extraction of alumina from shale. (To be continued.)

1-67. Scientists Fight to Save an Iron Empire. *Science Illustrated*, v. 2, June 1947, p. 36-41, 64.

Research on beneficiation of Mesaba taconite.

1-68. The Chemical News Parade. Aluminum From Clay. *Chemical and Engineering News*, v. 25, June 2, 1947, p. 1590-1591.

Picture story of the hydrochloric-acid extraction process, which has been developed to the pilot-plant stage. Flow diagrams.

1-69. Gold Recovery at Croesus Proprietary Treatment Plant. K. L. Brinsden. *Mines Magazine*, v. 37, April 1947, p. 15-18, 24.

Character of the ore, milling, concentration, roasting, refining, and costs. Flow diagrams for this Australian plant.

For additional annotations indexed in other sections, see: 26-79; 27-115.

2 SMELTING AND REFINING

2-92. The Effect of Temperature on the Phosphorus Reaction in the Basic Steelmaking Process. K. Balajiva and P. Vajragupta. *Journal of the Iron and Steel Institute*, v. 155, April 1947, p. 563-567.

Following the previous laboratory investigation of the phosphorus reaction in the basic steelmaking process at 1585° C., the work has been extended to two other temperatures—1550° C. and 1635° C.—employing a series of slags of varying lime content and with compositions covering the normal range of basic practice. In addition to the experimental technique already described, an X-ray examination of the rapidly quenched slags obtained in the present work has been carried out, and the results confirm the findings regarding the constitution of basic slags previously reported at 1585° C.

2-93. Fluidity of Furnace Killed Vs. Ladle Killed Basic Openhearth Heats. Daniel J. Murphy. *Blast Furnace and Steel Plant*, v. 35, May 1947, p. 558-559.

Experience at Scullin Steel Co. showed that fluidity can be obtained either by excessive temperatures or by letting the heat "liven up" a little or "come back" before tapping.

2-94. Steel-Melting Practice. Charles H. Herty, Jr. *Metal Progress*, v. 51, May 1947, p. 747-751.

Trends in steel production and ways whereby output may be increased through improvements in mechanisms and quality and form of the raw materials.

2-95. Antimony Smelting. *Metal Industry*, v. 70, May 2, 1947, p. 308.

German production methods are at the stage of the very early days of antimony smelting in England. (Based on a report made by the British Intelligence Objectives Subcommittee.)

2-96. Duplexing Low-Carbon Alloys. E. S. Renshaw and T. Foley. *Iron Age*, v. 159, May 22, 1947, p. 56-59.

The production of iron in the 1.20 to 1.45% C range in a duplexing setup involving a basic cupola and an acid electric furnace. This arrangement, designed to provide 180,000 lb. of hot metal per 9-hr. shift for the continuous pouring of automotive parts, is said to result in a high degree of uniformity of composition and temperature and in a sulphur maximum of 0.08%. An unusual chute arrangement for charging the electric furnace and the use of acid monolithic hearths and water-cooled roofs.

2-97. A Statistical Method and Results of a Study of Factors Affecting Openhearth Production Rate. A. P. Woods and C. R. Taylor. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 15-31.

Results of use of a punched-card technique for the study of 20 variables.

2-98. Effect of Charging Rate on Production. Vernon W. Jones. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 32-35; discussion, p. 35-41.

Investigation conducted at American Rolling Mill Co.

2-99. Limestone and Lime of Openhearth Quality. D. E. Washburn. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 44-46; discussion, p. 46-47.

Effects of different compositions and of sizing.

2-100. Limestone Solution in the Basic Openhearth Furnace. Michael Tenenbaum and J. S. Griffith. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 47-56.

Information on the mechanism of limestone solution from data obtained in a petrographic study of lime lumps removed from the openhearth furnace during the period following the addition of hot metal.

2-101. Desulphurization of Pig Iron by Addition of Soda Ash. C. L. Labeka. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v 29, 1946, p. 56-58; discussion, p. 58-60.

Techniques used at Pittsburgh Steel and results obtained.

2-102. Substitution of Coke for Pig Iron in Openhearth Charge. Oliver P. Luetscher. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 60-64; discussion, p. 64-65.

Results of a study which included evaluation of several variables such as charge composition and sulphur content of the coke.

2-103. Some Factors Affecting Excess Air Requirements in the Melting Chamber. M. Tenenbaum and J. M. Brashear. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 121-132.

Continuous recording of oxygen in waste gases made possible the analysis of combustion characteristics and air requirements throughout a number of openhearth heats. Primary factors affecting the oxygen content for any given furnace are shown to be proportion of fuel and air, furnace pressure, and excess air required to burn the products of bath reactions.

2-104. Practical Aspects of Desulphurization. H. B. Emerick, T. E. Brower, Philip Schane, Jr., and C. T. Scott. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 146-151.

Individual comments of representatives of Jones and Laughlin Steel Corp., U. S. Steel, Carnegie-Illinois and Bethlehem Steel.

2-105. Influence of Operating Variables on Ladle Reactions in Low-Carbon Rimmed Steel (0.10% Carbon or Under). P. W. Nutting and C. C. Brown. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 152-157; discussion, p. 157-161.

The variables of operating practice in the openhearth and some basic statistical data regarding the conditions that accompany ladle reactions.

2-106. Oxygen in Liquid Openhearth Steel—Oxygen Content During the Refining Period. T. E. Brower and B. M. Larsen. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, p. 162-176; discussion, p. 176-186.

A study of oxygen content of a large number of liquid steels in the furnace and of activity of oxygen in the slag, when a steady state is approached—this being usually near the end of the refining period.

2-107. Grain-Growth Inhibitors in Steel. James W. Halley. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 187-197; discussion, p. 198-200.

An investigation of the effects of some of the more common grain-growth inhibitors used in production of fine-grained steels.

2-108. Openhearth Practice to Meet Hardenability Requirements. A. G. Forrest and J. V. Russell. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 200-206.

Effects of composition and residual alloys and of deoxidation on hardenability as determined by the Jominy and "S.A.C." tests.

2-109. Melting to Hardenability. Elliott A. Reid. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 211-214.

System by means of which open-

hearth operators aim to obtain a specified hardenability, rather than a specified composition. To do this, a table of hardenability factors corresponding to the amounts of the elements found in carbon and alloy steels has been established, based on the logarithms of the Grossmann factors.

2-110. Summary of Questionnaire on Deoxidation of Semikilled Steel. M. Tenenbaum. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 222-226.

Following features of deoxidation practice on structural and plate grades of semikilled steels are covered by replies from 29 plants: manganese and silicon analysis of three selected carbon ranges; weight and timing of bath additions; weight of ladle additions; mold size and ingot weight; weight and timing of mold additions; and alloy analysis.

2-111. Use of Electrolytic Manganese. F. T. Sisco, R. H. Isenberg, J. F. Pollack, and L. A. Lambing. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 226-228.

Experience at Bureau of Mines, Pittsburgh Steel, and Jones and Laughlin Steel using electrolytic manganese in steelmaking.

2-112. Effect of Temperature on Cleanliness, Macrostructure, Microstructure and Grain Size. J. F. Pollack, R. H. Isenberg, and A. H. Jolly. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 243-248.

Effect as investigated at Jones and Laughlin, Pittsburgh Steel and Wisconsin Steel.

2-113. Molds and Pouring Practice. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 248-249.

Ingot-mold design and mold coatings.

2-114. Technique for Improving Low-Carbon Killed Steel of Carburizing Grades. L. W. Fleming. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 255-257; discussion, p. 257-261.

Probable causes of poor surface and internal quality and possible methods for minimizing them. The principal factors found to be of importance were: selection of raw materials; melting and working; finishing and deoxidation; sulphur content; pouring practice and mold design; and soaking-pit practice.

2-115. Carburized, Tarred and Special Nozzles. J. L. P. McMahon and E. C. Hite. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 292-293; discussion, p. 293-294.

Experience with steel-pouring nozzles of different types at Pittsburgh Steel and Timken Roller Bearing Co.

2-116. Control of Acid Openhearth Heats Through Measurements of Slag Fluidity. James W. Linhart. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 299-308; discussion, p. 308-313.

The history of slag-fluidity testing and details of the fluidimeter developed by the Acid Open Hearth Research Assoc. An investigation of the use of this instrument for the control of low-carbon heats.

2-117. Use of Special Deoxidizers. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 316-319.

Ferro-Carbo and ferrotitanium as steel-melting deoxidizers.

2-118. Den Elektriska Stalugnens Utveckling Under Världskriget 1939-1945. (Development of Electric Smelting Furnaces During the War Years.) *Jernkontorets Annaler*, v. 131, March 1947, p. 75-102.

Discussion by the technical commission of Jernkontorets of Erik Sunström's report concerning the development of electric smelting furnaces published in v. 130, 1946, p. 477-552.

2-119. Blast Furnace Bell Development. Truman H. Kennedy. *American Iron and Steel Institute Preprint*, 1947, 12 p.

Development of a serrated-type bell at National Tube Co., McKeesport, Pa., to secure better charge distribution.

2-120. A Method of Estimating Blast Furnace Production and Coke Consumption. W. E. Marshall. *American Iron and Steel Institute Preprint*, 1947, 26 p.

An empirical method for calculating coke burned at the tuyeres per ton of pig iron without making use of oxygen blown per ton of iron produced. This figure is divided into the coke equivalent to the oxygen blown per day to give a good estimate of production.

2-121. Spectrographic Control of the Converter Blow. S. T. Jazwinski. *Iron Age*, v. 159, May 29, 1947, p. 50-57.

Attempt is made to correlate the end point with the disappearance of certain spectrum bands, in side-blown Tropenas converter operation, and to predict the composition of the bath and the temperature during a blow by the atomic spectrum. New concepts of converter metallurgy developed during wartime research in England.

2-122. Direct Oxidation. E. B. Hughes. *Blast Furnace and Steel Plant*, v. 35, June 1947, p. 677-686.

Results of a series of experimental heats in which oxygen was used for refining low-carbon heats at the Steubenville Works of Wheeling Steel Corp. Oxygen at 100 psi. was introduced into the bath by a pipe through the wicket hole. The chief advantages were a saving in time of heat and a saving in fuel. The fuel saving alone was sufficient to pay for the oxygen. (Presented at Conference of the National Open Hearth Committee of the A.I.M.E., Cincinnati, April 22, 1946.)

2-123. The Operation of Openhearth Furnaces With Coke Oven Gas. Part II. D. Kilby. *Blast Furnace and Steel Plant*, v. 35, June 1947, p. 707-713.

Warming-up furnace, working charge, removal of slag from the slag pockets. Factors governing smooth operation. Complete histories of samples of 0.06% C rimming steel, free-cutting steel and forging quality 0.29 to 0.32% C steel. (Paper read at meeting of Iron and Steel Institute of Great Britain.)

2-124. Developments in the Use of Blast-Furnace Gas at the Port Kembla Steelworks. H. Escher. *Journal of the Iron and Steel Institute*, v. 156, May 1947, p. 1-27.

A large number of gas producers have been shut down, and relatively inefficient producer-fired steel furnaces have been converted to firing with by-product fuels. This has resulted in substantial improvements in steelworks practice.

2-125. The Reduction of Arsenic Trioxide by Carbon and Carbon Monoxide. R. C. Vickery and R. W. Edwards. *Metallurgia*, v. 36, May 1947, p. 3-6.

Investigation shows that yield of metallic arsenic, by the reduction of arsenic trioxide with carbon, does not approach that indicated by theory. It is suggested that this is caused by the difference in specific heats and vaporization temperatures of the two components, and that the replacement of arsenic trioxide by arsenic compounds of lower vapor pressures may have some effect upon the yield.

2-126. Effect of Nozzle Size on Surface Quality. C. J. Hunter. *Iron and Steel Engineer*, v. 24, May 1947, p. 82.

In a 2 to 4-in. range of nozzle sizes, slab-surface qualities of the grades studied improve as nozzle sizes and pouring speeds are increased when teeming into molds of comparatively large cross-sectional area. (Abstract of paper presented before A.I.M.E., Cincinnati, Ohio, April 1947.)

2-127. Heat Problems in the Steel Industry. Victor Paschkis. *Iron and Steel Engineer*, v. 24, May 1947, p. 83-87; discussion, p. 87.

How to use the electrical analogy method in the solution of many heat flow problems in the steel mill which cannot be conveniently solved by other methods. Heat flow in melting furnaces, ingot solidification, soaking pit and reheating; neat flow analysis. 13 ref.

2-128. Oxygen Content of Liquid Steel. *Industrial Heating*, v. 14, May 1947, p. 778-780.

Summarizes papers by C. E. Sims, of Battelle Memorial Institute, and J. H. Richards, of Carnegie-Illinois Steel Corp., presented at recent conference of the National Open Hearth Committee of A.I.M.E.

2-129. Melting Semikilled Steel in the Basic Electric-Arc Furnace. *Industrial Heating*, v. 14, May 1947, p. 782.

An experimental melting program on semikilled steel, conducted in 70-ton basic electric furnaces at the South Chicago plant of Republic Steel Corp. A single-slag process was developed which provides a method of charging for fast melting; tapping without blocking, with all additions to the ladle; and pouring in open-top molds.

2-130. Titanium. *Metal Industry*, v. 70, May 16, 1947, p. 363-364.

Three German methods of production. (From a recent B.I.O.S. report.)

For additional annotations indexed in other sections, see:
3-145-156; **10**-90; **13**-24; **14**-163-164-167; **16**-64-65-66-67-68-69-70-72-76; **17**-43-44-45-47-48-52-53-60; **25**-74-75; **27**-108-111.

3 PROPERTIES OF METALS AND ALLOYS

3-144. Changes in Volume During Magnetization and the "Invar" Alloys. Ulrich Dehlinger. *Battelle Translation from Zeitschrift fur Metallkunde*, v. 28, no. 7, 1936, p. 194-196. 10 p.

In the previous paper by the same author, the progress of the exchange integral was established as a function of the atomic spacing for a series of metals on the basis of the comparison of momentum of ferromagnetic saturation of different crystal lattices. It is shown that the above fact may explain the volume increase during magnetization and also the properties of the Invar iron-nickel alloys.

3-145. Abnormal Creep in Carbon Steels. J. Glen. *Journal of the Iron and Steel Institute*, v. 155, April 1947, p. 501-512.

Short-time creep tests at a stress of 17,600 psi and a temperature of 450° C., on a series of low-carbon steels containing 0.4 to 1.5% of manganese, 0.01 to 0.15% of silicon, and 0.00 to 0.11% of molybdenum, with varying amounts of aluminum up to 3 lb. per ton, show that manganese, silicon, and molybdenum within the limits examined reduce the creep rate, and that the abnormal creep resulting from aluminum additions is reduced considerably by these elements. In production casts of basic openhearth steel it is shown that, with proper control, aluminum may be used as a deoxidizer, provided that the steel remains coarse-grained as measured by the McQuaid-Ehn test.

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and prevent water leakage and possible fouling.

Truncated-cone electrodes for spot welding, according to their manufacturer, P. R. Mallory Co. (R-744), dissipate heat rapidly and reduce mushrooming because of their special contour. A new line of copper-tungsten alloys for resistance welding electrodes has been introduced by Ampco Metal (R-745) for long periods at high heat and pressure, or for conditions where water cooling is not adequate.

Arc Welding Electrodes

The newly developed lime-ferritic electrodes that minimize underbead cracking by generating a gaseous atmosphere around the arc composed essentially of carbon dioxide and almost free of hydrogen are exemplified by Metal & Thermit Corp.'s HTS type (R-746). They are particularly successful in welding high-sulphur free-machining steels, high-carbon steels, cold rolled steels and cast iron.

A complete line of stainless steel electrodes is now available from both Air Reduction Sales Co. (R-747) and Wilson Welder & Metals Co. (R-748). They are furnished with a heavy extruded lime-type coating for d.c. application, and all but the straight chromium analyses are obtainable with a lime-titania coating for either a.c. or d.c. that eliminates arc blow with resultant ease of manipulation, uniform arc action and better appearance. G.E.'s new line of stainless electrodes (R-749) comes in two types of coatings—one for either a.c. or d.c. use, and the other for reverse polarity d.c. operation.

Nickel-cored electrodes for machinable welds on cast iron have been introduced by several firms. Air Reduction Sales Co. designates it No. 375 (R-750) and Harnischfeger Corp. calls it Nicast (R-751). Page Steel & Wire Division's Ni-Cast (R-752) has a coating which is free of fluorides and other ingredients which generate injurious gases, and General Electric Co. says that the extruded black covering on its W-2075 (R-753) contains arc-stabilizing ingredients and is largely consumed in the arc, producing little slag.

Wilson Welder and Air Reduction have announced an improved electrode for welding high-strength chromium-molybdenum aircraft steels that minimizes susceptibility to cracking even when the metal is not preheated. Welds are ductile and will show tensile strengths up to 150,000 psi. Airco identifies it as No. 190 (R-754) and Wilson as No. 524 (R-755). Shield-Arc LH-70 (R-756) made by Lincoln Electric Co. has a low-hydrogen, low-moisture coating and is designed for use with d.c. polarity. Weld tensile strength is 70,000 to 80,000 psi. and elongation 25 to 30%. Preheating of high-tensile low-alloy steels can be eliminated or largely reduced, and high-carbon steels, high-silicon electrical sheet, and high-sulphur steels can be successfully welded.

A new line of six mild steel and four low-alloy, high-tensile steel electrodes known as Weld-Arc (R-757) is being introduced by Alloy Rods Co. to supplement its stainless and special-purpose electrodes; the ten types will fit any requirements for a.c. or d.c. welding, in any position. Large-size electrodes for mild steel have been brought out by Westinghouse as SW-2 (R-758); they

Bucket Teeth and Hammer Mill Castings With McKay Hardalloy Overlays

are available in four diameters from 3/16 to 5/16 in. Westinghouse also has a new high-tensile electrode, DH-MO (R-759) ranging from 3/32 to 1/4 in. diameter. A. O. Smith Corp.'s SW-16 (R-760) is a high-speed, heavy-coated, all-position electrode for welding light-gage mild steel sheets, and Wilson Welder's improved No. 107 for mild steel (R-761) is especially recommended for single or multiple-pass welding on rusty or dirty plates or sections.*

In the nonferrous field, General Electric Co. offers tungsten electrodes for atomic-hydrogen and inert-arc welding in diameters ranging from 0.4 to 0.5 in. (R-762), and Arcos Corp. has a product trade-named Monend (R-763) for welding Monel—either wrought, cast or clad. Ampco Metal has improved the coating on its Ampco-Trode "AC" aluminum bronze electrode (R-764) to eliminate hard striking and snuff-outs. It can be used with a.c. transformers having a 75 to 85 open-circuit voltage and with d.c. generators, for welding dissimilar metals as well as copper alloys, cast iron, and some nickel alloys. During the past year Ampco also introduced Beryl-Trode (R-765), a beryllium-copper composition with a medium-weight flux coating for stabilizing the arc, fluxing the oxides formed, and producing a dense deposit.

In the field of automatic welding, a novel idea for transferring electricity to the electrode without the necessity of cutting the coating is incorporated in the Shield-O-Matic electrode developed by National Cylinder Gas Co. (R-766). It consists of a deeply grooved inner steel core that is helically wound with fine wires and then given a heavy coating of flux through which portions of the wire grid extend to the surface to conduct the welding current to the core. The electrode is extremely flexible and can be deeply bent without losing flux. It is fed into the mechanically maintained arc from a reel.

*See end of article, page 19, for note about a new steel electrode being made by Eutectic Welding Alloys Corp.

Reid-Avery Co. has also introduced an automatic electrode known as the Raco composite Type A (R-767) made by spiraling six contact wires about a grooved electrode and coating with flux. It is available in coils in most of the common A.W.S. type numbers and in three grades of hard surfacing material. It can be used with any standard automatic arc welding head in any position. For flat position operation, Wilson Welder and Metals Co. has Una automatic wires and Una tapes (R-768). Five knurled-type wires and five flux-impregnated tapes comprise the line; they are made in several diameters and alloy analyses.

Hard Surfacing

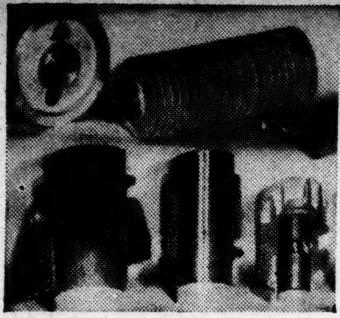
Designed for protection of new parts as well as repair of worn equipment, a new hard surfacing electrode has been introduced by McKay Co. (R-769) as Hardalloy. In laboratory tests a welded pad with a hardness of Rockwell C-60 was subjected to 90,000 blows at 250 in-lb. per blow with no cracking or spalling. A low-hydrogen coating on this electrode minimizes underbead cracking in the heat-affected zone, and smooth buildup per pass reduces the amount of grinding necessary after facing.

A wear resistant electrode for hard facing heavy equipment is known as the "coated Stoody self-hardening" (R-770). It is a fabricated rod consisting of mild steel tubes filled with alloying elements, and differs from Stoody Co.'s dipped electrodes in having a heavy extruded flux coating. Amsco Resistwear (R-771) made by American Manganese Steel Division is a high-carbon, shielded-arc electrode containing chromium and molybdenum, that can be deposited on any ferrous base. It is an excellent substitute for manganese steel parts on applications subject to abrasion but low impact.

Fabrialloy (R-772) made by Industrial Overlay Metals Corp. is a shielded high-carbon electrode that will give a buildup of 0.50 to 0.60% carbon steel, and Champion Rivet Co. has a new C-30 electrode (R-773) for building up of worn surfaces on shafting, pins and bushings.

Wall Colmonoy Corp.'s Sprayweld process (R-774) that combines the advantages of hard facing and metallizing was described in the June issue of *Metals Review*, page 13. It utilizes a special alloy known as Colmonoy No. 6—a powder metal held together with a special plastic binder in rod form, fed through a metallizing gun and fused into a hard surface.

A patented method of chemically bonding aluminum and its alloys to ferrous metals to form bimetallic assemblies is known as the Al-Fin process developed by Al-Fin Corp. (R-775). Such structures have the strength of steel with the light weight, high heat conductivity, corrosion resistance and other characteristics of aluminum.



Assemblies of Aluminum Bonded to Steel by the Al-Fin Process

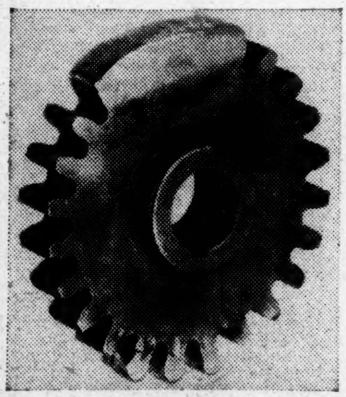
Pure aluminum and any of the common aluminum casting alloys can be bonded successfully to cast iron, Ni-Resist, carbon and alloy steel. Typical applications are for engine cylinder barrels, heat exchangers, sleeve bearings, pipe and tubing.

Gas Welding

One of the latest developments in oxy-acetylene welding is the use of flux-coated rods. Not only is the exact amount of flux applied for the corresponding amount of filler metal, but such rods enable the operator to devote his entire attention to the weld, without interruptions to dip the rod into a jar of flux; cleaning of the joints is also easier. Eutectic Welding Alloys Corp. has introduced a new line of such flux-coated rods known as FC EutecRods (R-776) for cast iron, steel, copper and aluminum, all made in Eutectic's special compositions that provide low-temperature bonding.

For instance, EutecRod 16FC is recommended for steel; it bonds at 1300 to 1600° F., and has a tensile strength of 73,000 psi. For brass, 18FC produces an excellent color match and is bead-forming and thin-flowing at 1625° F. Aluminum is welded at 950 to 1075° F. with EutecRod 2100, producing a clean joint of 29,000 psi. tensile strength.

Linde Air Products Co.'s flux-coated bronze welding rod is known as Oxweld No. 25M (R-777). The coating consists of Brazo flux plus a nonactive binder that does not affect the weld.



Steel Gear Showing Weld Made With EutecRod 16FC

Low-temperature welding rods are also made by All-State Welding Alloys Co., which has two new nickel-silver welding rods (R-778); one is suitable for low-temperature welding of steel, stainless steel, copper-nickel, and nickel; the other for repair of worn or broken parts or use where resistance to frictional wear is desired.

For welding copper, Air Reduction Sales Co. has developed a silicon-copper rod, the Airco No. 23A (R-779), superior to phosphorus-deoxidized copper in flowing characteristics and strength.

A new welding torch, Model W-46, has been announced by Weldit, Inc. (R-780). It has a handle-length lever which makes it possible to shut off or release gas with fingertip pressure, and a built-in automatic Gasaver which eliminates two thirds of the usual gas wastage.

An attachment which can be used with any standard oxy-acetylene welding torch to adapt it for body soldering, tinning and light brazing with an acetylene-air flame is made by the Acet-A-Tip Co. (R-781), and a somewhat similar device is made by Cesco Products, Inc., and is known as the Cesco Puddler (R-782).

Cutting

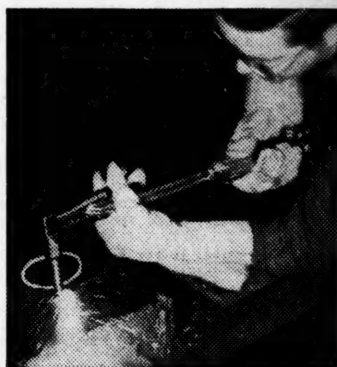
Three new methods for cutting stainless steels and other metals difficult to cut by standard oxygen methods have been developed. One is the Oxyarc process originated by Arcos Corp. (R-783) that cuts by a combination of an electric arc and a stream of oxygen. The arc is established between the metal to be cut and a coated tubular rod known as Oxycuttend rolled from low-grade mild steel, through which oxygen is fed. The rod is consumed as it cuts, and the holder is so constructed that new ones can easily be inserted. It is a manual process and can be used wherever an a.c. or d.c. welder and cylinder oxygen are available. As an example of its ease and simplicity of operation, a welder with less than two days' experience was able to make a 54-in. cut in ⅜-in. monel in 20 min.

The second method was developed by Linde Air Products Co. and is known as the powder-cutting process (R-784). A finely ground iron-rich powder is introduced at the blowpipe nozzle; it burns in the cutting oxygen stream, creating an extremely high temperature that melts and washes away the oxides that prevent cutting at the lower temperature of the standard process.

Both a hand blowpipe and a mechanical attachment have been developed for this process. The Oxweld AC-4 blowpipe (R-785) has the usual oxygen and acetylene hoses, plus a third hose which conducts the powder from a dispenser by compressed air. The same valve lever that turns on the cutting oxygen also starts the powder flow. The attachment for the standard Oxweld C-39 machine-cutting blowpipe is known as the C-39 ACA-2 (R-786), and consists of a powder valve, a powder nozzle and an interconnecting tube for powder flow. It will cut stainless steels ranging from ⅛ to 3 in. thick at speeds of 20 to 7 in. per min., respectively.

The third method for cutting stainless steel can also be either hand or mechanically operated, and is known as the flux-injection process, equipment for which has been developed by Air Reduction Sales Co. (R-787). It consists in injecting powdered flux into the cutting oxygen in selected quantities automatically and directly to the point of cut. A three-hose cutting torch is employed, with the addition of a simple flux feeder, which is a portable hopper with capacity of 20 lb., and a vibrator type flux dispenser which varies the amount of flux delivered by rheostat control.

A new cutting torch of standard type is a large one for heavy work called the Pacemaker (Liquid Carbonic Corp., R-788). It is 20 in. long and weighs 3½ lb. and is designed with a free-flow mixing chamber and a recessed tip seat not easily damaged.



Liquid Carbonic's Pacemaker

A torch attachment for cutting accurate circles, curves or straight lines in plate is made by Scientific Research Co. (R-789) as the Flash circle burner. It can be used either vertically or horizontally and has simple height and radius adjustments. The portable circle cutter made by Ohmstede Machine Works (R-790) consists of a semicircular base, a main column and an overhead aluminum arm housing the power unit and hydraulic speed control. A vertical drive spindle projects from the horizontal upper arm to carry the torch, while a second vertical shaft is tipped with a point that rests in a center punch mark. A rack adjustment enables the torch to be set for circles up to 40 in. in diameter.

To simplify the cutting of long or warped surfaces Gaso Equipment Co. is marketing an attachment for its V-10 cutting machine (R-791). This device guides the machine alongside any channel or angle (preferably a

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3-146. Electroplating and Cathodic Pickling as Causes of Hydrogen Embrittlement. Carl A. Zapffe and M. Eleanor Haslem. *Wire and Wire Products,* v. 22, May 1947, p. 351-356, 379-381.

A new bend test said to be especially suited for measuring brittleness of wire specimens. Effects of pickling time, bath temperature, and bath impurities on hydrogen embrittlement during cathodic pickling. Hydrogen absorption is identical for acid or for alkaline electrolytes. Quantitative evaluation of embrittlement caused by chromium plating and by cadmium plating. Both the latter are shown to cause embrittlement equaling or exceeding that caused by cathodic pickling.

3-147. Fracture of Metals. *Metal Industry,* v. 70, May 2, 1947, p. 307-308.

Metallurgical and mathematical viewpoints of fracture and relative merits of each.

3-148. Materials Work Sheet. Meehanite. *Machine Design,* v. 19, May 1947, p. 147-150.

Types available; characteristics; applications; fabrication; heat treatments; resistance to corrosion; material designations.

3-149. High-Temperature Characteristics of 17 Alloys at 1200 and 1350° F. J. W. Freeman, F. B. Rote, and A. E. White. *National Advisory Committee for Aeronautics Wartime Report W-93,* March 1944, 106 p.

Results of a study of the rupture-test characteristics of 13 wrought and 4 cast alloys which have promise for service in exhaust-gas turbines. The results are not too conclusive because of the fact that differences in fabrication procedure and heat treatment often cause more variation than wide differences in chemical composition.

3-150. Copper Addition Contaminants. Effect on Mechanical Properties of Gray Cast Iron. K. E. Rose and C. H. Lorig. *American Foundryman,* v. 11, May 1947, p. 83-93.

Results of experiments undertaken to determine what harmful effects might result from use of copper-base alloys and the extent to which they can be safely employed as a source of copper for gray cast iron.

3-151. Temper Brittleness. R. H. Greaves. *Iron and Steel,* v. 20, May 1947, p. 175-178.

A critical review of recent French investigations.

3-152. Cast Iron and Steel. (Continued.) Ernest C. Pigott. *Iron and Steel,* v. 20, May 1947, p. 181-183.

Properties and applications of the nickel steels and cast irons.

3-153. Average Ultimate Strength of Materials. *Materials & Methods,* v. 25, May 1947, p. 119.

Table of various metals and their forming based upon physical experiments conducted in the laboratories of E. W. Bliss Co.

3-154. Properties and Fabrication of Aluminum Alloys. *Materials & Methods,* v. 25 May 1947, p. 121.

Comparison with other metals; precautions to be observed in fabricating.

3-155. The Magnetic Quenching of Superconductivity. J. W. Stout. *Physical Review,* v. 71, May 15, 1947, p. 741.

Disagrees with Sienko and Ogg's expression for the destruction of superconductivity of "soft" superconductors such as Pb, Hg, Sn, In, Tl, CuS, Au_2Bi, Zn and Cd.

3-156. Cast Jominy Tests for Determining Hardenability. H. B. Wishart. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.,* v. 29, 1946, p. 214-221.

An experimental program indicated that good agreement exists between the hardenability results from the Jominy specimens from forged billet sections and those from cast specimens obtained on the pouring platform during teeming. In view of results obtained, direct-cast-specimen hardenabilities are now used for preliminary control of heats at Gary Steel Works.

3-157. Engineering Properties of Heat Treated Cast-Irons. J. S. Vanick. *Foundry Trade Journal,* v. 82, May 15, 1947, p. 53-56.

Standard practices of heat treating and properties produced by this treatment. (From paper presented at the Cleveland Meeting of the American Foundrymen's Association.)

3-158. Hot Shortness of the Aluminum-Silicon Alloys of Commercial Purity. A. R. E. Singer and P. H. Jennings. *Engineering,* v. 163, May 2, 1947, p. 369-371.

An extensive study of the mechanism of hot shortness and its dependence on composition and mechanical properties at high temperatures. (Condensed from paper presented before the Institute of Metals, March 5, 1947.)

3-159. Boron in Medium Carbon Steel. G. P. Contractor and J. S. Vatchagandhy. *Metal Treatment,* v. 14, Spring 1947, p. 3-19.

Transformation temperatures, tensile and fatigue properties, Izod impact values, creep resistance, case-hardening behavior, and hardenability of a series of medium-carbon steels. 19 ref.

3-160. Low-Temperature Physics and the Theory of Metals. E. B. Mendoza. *Metal Treatment,* v. 14, Spring 1947, p. 20-28.

Relationships of the above clarified for the metallurgist.

3-161. Alcomax II Permanent Magnet Alloy. *Edgar Allen News,* v. 25, May 1947, p. 826-827.

An anisotropic alloy that has the highest field strength obtainable from any permanent magnet system.

3-162. Effect of Sulphur in Cast Steel. *Industrial Heating,* v. 14, May 1947, p. 784.

The more important effects.

3-163. Light Alloy Piston Materials. A. Schofield and L. M. Wyatt. *Institution of Automobile Engineers Journal,* v. 15, May 1947, p. 251-294.

Properties of the various materials; how to choose the proper alloy for various requirements; methods of fabbrication; and conditions of temperature and loads for different automobile, aircraft, and diesel engines.

3-164. Titanium—Some Properties and Applications. H. W. Greenwood. *Metallurgia,* v. 36, May 1947, p. 44.

A brief discussion.

3-165. Brittleness in Metals. Part I. Embrittlement of Deoxidized Copper by Bismuth. *Metal Industry,* v. 70, May 16, 1947, p. 361, 365.

Possible reasons for the above phenomenon.

3-166. "Spoiling" of Tungsten Steel. K. Hoselitz and M. McCaig. *Nature,* v. 159, May 24, 1947, p. 710.

Experiments substantiate theory that the spoiling—loss of coercive force on keeping at 950 to 1000° C. prior to hardening—of tungsten magnet steel is caused by the formation of a separate carbide phase which reduces amount of tungsten and carbon available to promote hardening.

For additional annotations indexed in other sections, see:
2-108; **4**-66; **9**-64-65; **13**-24; **18**-104-107-113; **20**-259; **23**-201; **24**-146-164-171; **27**-106-115.

4 STRUCTURE — Metallography & Constitution

4-60. Microstructures and Structural Diagrams for Fe-Ni-Cr Alloys. Anton deS. Brasunas and James T. Gow. *Metal Progress,* v. 51, May 1947, p. 777-780.

Forty photomicrographs show structures of series of cast Fe-Ni-Cr alloys containing 0.4% C, 1.2% Si, and 0.8% Mn, annealed 100 hr. at 1800° F. Phase diagrams. The work was done at Battelle Memorial Institute under the sponsorship of the Alloy Casting Inst.

4-61. 18-8 Steel in Exhaust Systems. Wilson G. Hubbell. *Aero Digest,* v. 54, May 1947, p. 92, 95, 145-146.

Results of an investigation of aircraft exhaust manifold failures. It is shown that the metal picks up carbon from the products of combustion, thus theoretically rendering it more liable to intergranular corrosion. However, no evidence of this type of corrosion was found in spite of increased carbon content. The effects of variations in composition and of heat treatment procedures on formability and weldability.

4-62. Structure of Graphite. *Nature,* v. 159, May 10, 1947, p. 637-638.

Separate communications from J. B. Nelson and D. P. Riley and from H. P. Rooksby and E. G. Steard about experiments made to verify the existence of extra lines in the X-ray powder-diffraction pattern of graphite, reported by J. Gibson in a recent issue. In neither case were the reported lines found. The first authors believe Gibson's extra lines were caused by the presence of small amounts of iron, gold, mercury, and tungsten in the cobalt target plating.

4-63. Direct Determination of Stacking Disorder in Layer Structures. W. H. Zachariasen. *Physical Review,* v. 71, May 15, 1947, p. 715-717.

Irregularities in the relative displacement of the layers parallel to their own planes occur in many crystals of layer-structure type. This stacking disorder produces characteristic features in the X-ray and electron-diffraction patterns of such crystals. It is shown that the specific nature of the disorder can be directly deduced from the observed diffraction effects.

4-64. The Theory of Gases in Copper Base Alloys. L. W. Eastwood and J. G. Kura. *Foundry,* v. 75, June 1947, p. 82-83, 260-267.

Some of the fundamental work done on copper-gas systems; the effect of alloy composition, the role of oxygen, the basis for use of an oxidizing atmosphere and other commercial practices, the significance of the equilibrium constant, and the presence of gases in the solid metal. 22 ref.

4-65. On the Recrystallization and Strain-Relieving of 80-20 Cupro-Nickel Alloy. D. P. Chatterjee. *Engineers' Digest (American Edition),* v. 4, May 1947, p. 243-244.

Approximate lowest recrystallization temperature range was found to be 450 to 500° C., as shown by study of grain growth and change of hardness, tenacity, and ductility. (Translated from *Journal of the Geological, Mining and Metallurgical Society of India,* v. 18, March 1946, p. 1-4.)

4-66. The Physics of Sheet Steel. G. C. Richer. *Sheet Metal Industries,* v. 24, May 1947, p. 945-952, 962.

The phenomena of plastic deformation and ferromagnetism from a fundamental physical standpoint. Discussion of the physical properties of metals is based on a few essential atomic-lattice factors. (To be cont.)

(Turn to page 18)

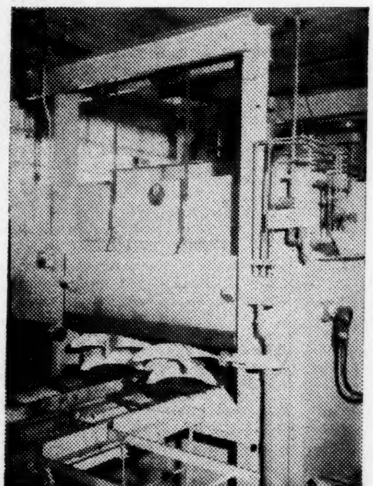
standard 4-in. structural channel), eliminating the need for special tracks. The machine runs on the plate being cut and follows its contours automatically.

Brazing

New equipment for brazing includes a portable 10-kva. brazer with air-cooled tongs introduced by Westinghouse (R-792). A single-phase, 60-cycle unit, it weighs 100 lb., has four wheels and two handles for ready movement, and requires only connection to a 220 or 440-volt source. A resistance brazer has been especially designed by Acro Welder Mfg. Co. (R-793) for the T-welding of tubular parts. The tubes are held in water-cooled copper alloy jaws and a foot switch initiates the timer and contactor to control the sequence of power.

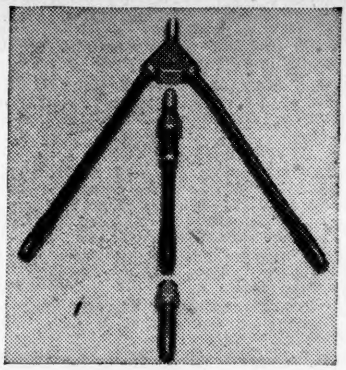
Several improved continuous mesh-belt conveyer furnaces have recently been installed by the Electric Furnace Co. (R-794) for brazing copper, brass, and aluminum, and for silver soldering miscellaneous steel and nonferrous assemblies. Conveyer belts range from 4 to 24 in. wide for handling from 60 to 750 lb. per hr. These furnaces operate at temperatures up to 2050° F.

Electric Furnace Co. has also developed several highly specialized electrically heated furnaces for brazing aluminum alloy assemblies (R-795). Fans and directional flow baffles circulate the heated atmosphere over the work and return it behind the baffles past the heating elements for reheating.



Charging End of Electric Furnace Co.'s Aluminum Brazing Furnace

Three new multiflame brazing tips have been added to Air Reduction Sales Co.'s apparatus line for use in silver brazing, high-temperature brazing and hard facing (R-796). Style 721 is fastened to a short, flexible copper extension. Style 722 branches into two tubes brazed to a single extension and is particularly suitable for refrigerator fabrication. Style 723 is for brazing operations where the operator must be at a distance from his work; it is used with a standard 10-in. extension tube.



Airco's Multiflame Brazing Tips

Among recent brazing alloys is Macoloy (R-797), the trade name of a series of phosphide copper-base alloys manufactured by McCauley Alloy Sales Co. Type E is fluid at 1150° F., Type F at 1180° F., and Type G fluid at 1600 to 1900° F.

The higher price of silver has induced Handy & Harman to investigate the possibilities of lower alloy content silver brazing materials with the result that two new alloys (Easy-Flo 45 and Easy-Flo 35, R-798) have been developed. Easy-Flo 45 contains 45% silver and additions of copper, zinc and cadmium. Its exceptionally low melting temperature ranges from 1120 to 1145° F. The 35% silver alloy has a wider melting range—1115 to 1295° F. but is still free flowing at a very low temperature for that composition.

Sherman & Co. also has a new silver brazing alloy known as Nu-Braze Super-Flo (R-799). With a melting point of 1076° F., it has good wetting and penetrating properties. Just introduced by this same company are two new silver brazing fluxes—Nu-Braze Wonderflux No. 25 (R-800), designed for long heating cycles as in furnace brazing or where massive pieces are torch brazed; and Nu-Braze Wonderflux No. 17 (R-801), for high-speed production brazing with induction heat. No. 25 begins to melt at 480° F., and remains active above 1500° F. No. 17 features low viscosity and is water-thin at 800° F., so that it thoroughly wets the joint area in a few seconds.

A silver brazing paste that can be applied with a few strokes of a soft brush is another new product of Sherman & Co. known as Nu-Braze Paste No. 40 (R-802). Nu-Braze Diffusion Paste No. 50 was developed specifically for brazing carbide tips to tools.

Welding Equipment & Supply Co. (R-803) has announced a series of new National welding and brazing fluxes—namely, No. 5 for welding cast iron; No. 10 for brazing iron, steel, malleable and brass castings; No. 15 for brazing gray iron and malleable castings; No. 20 for brazing brass, bronze and copper.

For brazing sheet aluminum All-State Alloys Co. has announced flux No. 31A with a melting point of around 950° F. (R-804), and Air Reduction Sales Co. has also developed a new flux for brazing aluminum under the trade name Elite (R-805).

Solder

An aluminum solder developed in Switzerland and known as Prolyt is now being manufactured and distributed in this country by the Aluminum Solder Corp. (R-806). Independent laboratory tests of this material, when used to solder aluminum to aluminum without a flux showed that it resisted shearing after a 250-hr. salt spray test, even though the base metal broke. Electrical resistance of a soldered joint between aluminum wire and a copper lug was about 20 microhms, and this increased only 8 microhms after the salt spray test. Vibration tests were also conducted on the wire and while the cable broke, the solder itself did not fail.

A rub-on solder, recommended for filling and soldering aluminum where tightness is essential but strength unimportant, is made by All-State Welding Alloys Co. (R-807). It is applied without flux at low temperatures, and can be used to repair cracks and build up worn surfaces on aluminum castings. All-State has also introduced No. 53 zinc-base die-cast rod (R-808) in 3/32-in. diameter with a working temperature of only 400° F.

A soldering flux in stick form, Flux-Stik made by Lake Chemical Co. (R-809), can be used for overhead and other out-of-the-way locations.

A wartime tin conservation order required that solder for electrical or radio use be limited to 40% tin. In order to meet this requirement and still retain the wetting and flowing properties of the higher tin alloys, Division Lead Co. has developed Divco 40/60 No. 180 rosin core solder (R-810). The rosin fluxes combined in the core of this wire not only wet the metal but also react with the solder itself to improve the flowing qualities. The solder is used at lower temperatures than ordinary cored solders and has good resistance to carbonization.

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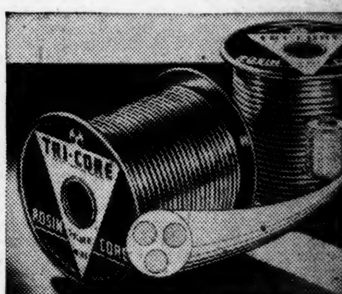

Alpha Tri-Core Solder

4-67. German Research on the Fine Structure of Metals. *Metal Treatment,* v. 14, Spring 1947, p. 41.

Outlines B.I.O.S. report by R. H. Cocke, A. H. Jay, N. K. Petch, and W. A. Wood.

4-68. The Application of Single Crystals to the Study of Tempered Martensite. G. Kurdjumov and L. Lyssak. *Journal of the Iron and Steel Institute,* v. 156, May 1947, p. 29-36.

Results of a study of the structure of tempered martensite using an X-ray camera provided with a special arrangement in order to increase its accuracy in measuring lattice constants. The product of the so-called "first transformation" in tempering is shown to be a partly decomposed solid solution of carbon in alpha iron. After tempering at 150° C., 0.3 to 0.5% carbon remains dissolved in the solid solution. It decreases as the tempering temperature rises. The kinetics of martensite decomposition has the character of a reaction of the first order. 15 ref.

4-69. Mecanisme de la Formation de l'Etat Ordonne dans une Solution Solide. (Mechanism of Disorder-Order Transformation in a Solid Solution.) Andre Guinier and Roger Griffoul. *Comptes Rendus,* v. 224, April 21, 1947, p. 1168-1170.

Investigation of the above mechanism in the solid solution $AuCu_3$, using an X-ray method, showed the importance of certain crystalline phases and periodicity in the transformation.

4-70. Absorption of Hydrogen by Aluminum Attacked in Caustic Soda Solution. C. E. Ransley and H. Neufeld. *Nature,* v. 159, May 24, 1947, p. 709-710.

The authors found a concentration of the order of 0.4 cc. per 100 g. of hydrogen dissolved in cast aluminum (99.99%) after immersion in 0.01 *N* caustic soda for 49 days. This is contradictory to the results reported by Moureau and Chaudron *(Comptes Rendus),* who found 1000 cc. per 100 g. of metal after 20 to 30 days absorption.

For additional annotations indexed in other sections, see: **2**-112; **3**-166; **5**-36; **6**-109; **9**-65; **10**-102; **18**-102; **19**-152.

5 POWDER METALLURGY

5-34. Powder Metallurgy—Process or Product? Earl S. Patch. *Iron Age,* v. 159, May 22, 1947, p. 64-66.

The favorable economic aspects of the use of metal-powder products. Recommends that powder metallurgy be considered a process rather than a product.

5-35. New Developments in Powder Metallurgy. G. J. Comstock and J. D. Shaw. *Iron Age,* v. 159, May 22, 1947, p. 67-68.

Production of precast powders and hot pressing of powders. Hot pressing appears to be the means of fabricating many of the precast alloy powders at pressures far below those now required by cold pressing.

5-36. Principe d'une Methode pour l'Obtention Rapide des Surstructures. Application aux Alliages du Type Pt-Fe. (Principles of a Method for the Rapid Production of (Relaxed) Structures. Application to the Alloys of the Pt-Fe Type.) Louis Weil. *Comptes Rendus,* v. 224, March 1947, p. 923-925.

Very slow cooling is necessary in order to obtain an orderly arrangement of the atoms in an alloy upon cooling. The author proposes the production of alloys having such structures by means of powder metallurgy. The production of Pt-Fe, Pt-Co, and Pt-Ni powders by reduction of the respective metal platinocyanates in hydrogen at 500 to 600° C. for 2 hr. The value of the method for preparation of alloys having extremely long relaxation times on cooling.

5-37. Progress in Powder Metallurgy. Earl R. Parker. *Mining World,* v. 9, May 1947, p. 25-27.

Summarizes techniques and developments in this field.

5-38. Expanding Metal Powder Use Stressed at Metal Powder Association Meeting. *Iron Age,* v. 159, June 5, 1947, p. 84-86.

Reviews papers presented.

5-39. Production and Uses of Iron and Other Metal Powders. *Chemical Age,* v. 56, May 17, 1947, p. 641-642.

German practice. (Abstracted from B.I.O.S. Report No. 706.)

5-40. Powder Metallurgy. Gregory J. Comstock. *Federal Science Progress,* v. 1, June 1947, p. 34-35.

Powder metallurgy process; applications and limitations; wartime advances.

5-41. Furnace Atmospheres for Sintering. Part I. Hydrogen. A. Webber and A. C. Hotchkiss. *Industrial Heating,* v. 14, May 1947, p. 742-744, 746, 748, 750, 752, 754.

Means for purifying and analyzing the gas, and equipment used. (Presented at 1946 meeting of Metal Powder Assoc., New York City.)

5-42. Production of Hot Plates by Powdered Metallurgy. *Machinery (London),* v. 70, May 15, 1947, p. 509.

Design of aluminum hot plate made in Germany.

For additional annotations indexed in other sections, see: **26**-70.

6 CORROSION

6-107. Corrosion in Storage Tanks for Crude Sulphate Turpentine. S. G. Norton, Gordon E. Lowe, and George M. Calhoun. *Paper Trade Journal,* v. 124, May 1, 1947, p. 34-35.

Factors which promote corrosion and preventative recommendations. Tests were made by exposing various metals in the vapor above the liquid in a small storage tank. Stainless steel, Everdur, or nickel should be satisfactory construction materials. Copper, aluminum, or hot dipped galvanized tanks might be satisfactory, but should be tested under operating conditions.

6-108. Reactions of Magnesium and Aluminum With Iodine and With Concentrated Sulphuric Acid. Leon McColloch. *Journal of Chemical Education,* v. 24, 1947, p. 240.

Experiments show that magnesium forms a passivating film in iodine which protects it even up to 600° C., while aluminum reacts readily. In cold 98% H_2SO_4, films are formed on both metals, but the one on aluminum gives only partial protection.

6-109. Influence des Facteurs Cristallographiques sur la Corrosion Intergranulaire de l'Aluminium de Haute Purete. (Influence of Crystallographic Factors on the Intergranular Corrosion of High-purity Aluminum.) Paul Lacombe and Nicolas Yannaquis. *Comptes Rendus,* v. 22, March 1947, p. 921-922.

Intergranular corrosion of aluminum caused by attack of HCl is not reduced on increasing the purity of the aluminum from 99.95% to 99.9986% (0.0002% Fe, 0.0009% Si, and 0.0003% Cu). Results of investigation indicate that the corrosion is caused by differences in the orientation of adjacent networks rather than by the presence of impurities.

6-110. Corrosion. Mars G. Fontana. *Industrial and Engineering Chemistry,* v. 39, May 1947, p. 87A-88A.

Pitting and dezincification.

6-111. Acetic Acid and Chlorine Vs. Materials of Chemical Plant Construction. *Chemical Engineering,* v. 54, May 1947, p. 241-242, 244, 246, 248.

Series includes articles on Haveg (a plastic material); stainless steel; miscellaneous resinous coatings; and lead.

6-112. Corrosion Tests in Distillation Equipment. W. Z. Friend and J. F. Mason, Jr. *Petroleum Engineer,* v. 18, May 1947, p. 192, 194, 198, 201, 204.

Results obtained from a number of plant corrosion tests in atmospheric crude distillation and in the separation, fractionation, and stabilization of the primary products from thermal cracking. Spool-type specimen holder used.

6-113. Rate of Corrosion of Lead by Hydrocarbon Solutions of Organic Acids. David Turnbull and Delton R. Frey. *Journal of Physical and Colloid Chemistry,* v. 51, May 1947, p. 681-704.

Effect of acid structure and concentration upon the corrosion rate of lead in hydrocarbon solvents, using atmospheric air as oxidizing agent.

6-114. The Kinetics of Dissolution of Cadmium in Hydrochloric Acid. June F. Zimmerman and Hugh J. McDonald. *Journal of Physical and Colloid Chemistry,* v. 51, May 1947, p. 857-868.

Results of a laboratory investigation. 16 ref.

6-115. Materials and Finishes for Tropical Service. C. D. Cook and C. Merritt, Jr. *Materials & Methods,* v. 25, May 1947, p. 77-80.

Humidity-testing procedure. Results of humidity and salt-spray tests on several metals with various types of surface finishes. The electrolytic behavior of certain materials.

6-116. Corrosion Coupons and Pipe Life Predictions—Revision of 1947. W. R. Schneider. *Corrosion,* v. 3, May 1947, p. 209-220.

Details of the procedures followed by Pacific Gas & Electric Co. in the use of coupons to evaluate corrosive conditions along their pipe lines. Results of their use over a ten-year period, showing the effects of various factors and correlations between actual pipe life and that predicted by analysis of coupon data.

6-117. Protective Coatings on Bell System Cables. V. J. Albana and Robert Pope. *Corrosion,* v. 3, May 1947, p. 221-226.

Development of various types of metal, plastic, and fabric coatings, and combinations of these materials, for protection of buried lead-covered telephone cables. (Presented at North East Regional Meeting of N.A.C.E., New York, Oct. 24, 1946.)

6-118. Anaerobic Corrosion of Iron in Soil. R. L. Starkey and K. M. Wight. *Corrosion,* v. 3, May 1947, p. 227-232.

The bacteria causing the corrosion; mechanism of the process; detection of the corrosion during early stages; effect of seasonal changes; resistance of pipe-wrapping materials to anaerobic corrosion. (Condensed from Report of Distribution Committee of A.G.A., 1945.)

6-119. A Study of the Corrosion of Copper Alloy Condenser Tubes. N. W. Mitchell. *Corrosion,* v. 3, May 1947, p. 243-251.

Some hitherto unpublished data derived from field corrosion tests, and the present state of our knowledge of the corrosion of copper alloy condenser tubes in refinery and gasoline-plant service. (Presented at A.S.M.E.

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One of the difficulties in using cored wire solders has been the occurrence of skip spots or dry sections of insufficient flux. To eliminate this trouble Alpha Metals has devised Tri-Core (R-811), a solder with three independently filled cores of rosin flux. The three cores are close to the surface, and because of the thin walls, the solder melts quickly and heat penetrates to the flux rapidly, allowing it to flow freely and reach the work ahead of the solder.

National Lead Co. has solved this same problem by designing a wire known as Fluxrite (R-812). Instead of a center core the flux is placed on the outside of the wire in four channels equally spaced around the periphery. Since the flux melts at a temperature 250° F. lower than the solder, it liquefies first and flows onto the work before the solder has fully melted. In manufacture of this wire, flux gaps are eliminated by repeating the flux-loading a number of times to insure that the four channels are completely filled.

Fixtures and Positioners

A positioning fixture to facilitate automatic arc welding has been invented by Mark F. Gouran (R-813). It includes a Lincolnweld automatic welding head traveling on a vertical beam to a height of 8 ft. The assembly rotates about a fixed axis to a maximum radius of 20 ft.

A positioner with universal balancing made by Aronson Machine Co. comes in two models of 200 and 500-lb. capacities (R-814). The pressure of a finger can move the work to any angle with 360° rotation on three axes—the head axis or swivel plate, the spindle axis or work plate, and the pedestal axis. A universal positioner for light work which turns 360° on the vertical plane is made by Garfield Engineering Corp. as the Powrarm M-1 (R-815). A mechanical principle of pressure applied to a ball and socket joint permits "turn of the wrist" movement.

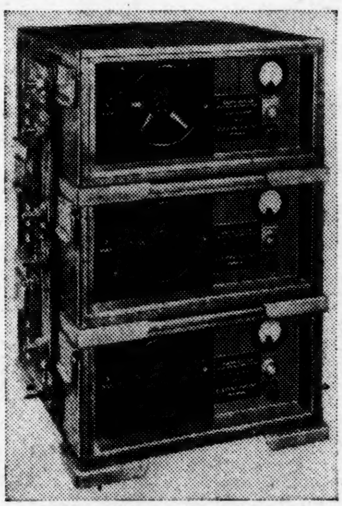
A power-operated bench model positioner 1-P (R-816) is a product of Ransome Machinery Co. Work weighing up to 100 lb. can be tilted up to 135° and locked in position at any tilt. It can also be revolved over 360° by a ⅛-hp. single-phase reversible motor. Rotary speeds range from 0.21 to 5 r.p.m.

A fixture for the seam welding of rounds, squares and other shapes of tubes and tanks was created because of the necessity for fast production of shell containers. It is used with an automatic seam welder manufactured by Victory Engineering & Machine Works (R-817). In this machine the welding head remains stationary and the work moves under the head in a continuous stream. It has a variable speed range of 60 to 150 in. of weld per min.

Duo-Square work holders designed by McFerron Myers Products Co. (R-818) are cast aluminum alloy brackets supporting two clamping faces that are either positioned at fixed angles or adjustable to any angle, depending upon the model. Either round or square bars, flats or angles can be held securely enough to weld, braze or solder without distortion.

Miscellaneous Equipment

A portable induction heater, the Model UP, for preheating and normalizing for welding has been announced by Electric Arc, Inc. (R-819). It is manufactured in units, of 10 kva., which may be stacked on the job to form groups of two or three, stepping up capacity to 20 or 30 kva. Each unit is complete in itself containing power unit, contactor, meters and control supply. A selector switch varies heating current and voltage output.

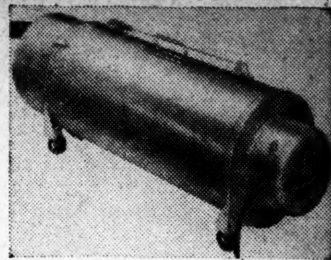


Portable Induction Heaters for Welding Made by Electric Arc

A trimmer for removing upset metal from flash or butt welds is available from Morton Mfg. Co. (R-820) in sizes ranging from 12 to 28 in. of trimming capacity and ¼ in. of metal thickness. It has a lower horn for circular work that will accommodate a minimum diameter of 9 in. Each of the upper and lower rams has three or more tool holders.

A welding booth slightly over 9 ft. square and 7 ft. high is a new product of Hobart Brothers (R-821). It is constructed of panels of 16-gage sheet steel formed with companion flanges, punched on 12-in. centers for bolting assembly. An exhaust fan draws in fresh, cool air through an opening in the top, and expels the hot, fume-contaminated air to the outside of the building. Also for the protection of the welder is a small welding fume exhauster made by Mine Safety Appliances Co. (R-822).

To simplify drawing the appropriate welding symbols on parts, Rapidesign, Inc., has put on the market a No. 34 welding templet (R-823). It is made of mathematical quality plastic, with the standard symbols and notes laminated between the plastic sheets so they cannot wear off.



Welding Fume Exhauster

Late Additions

Too late for inclusion in proper sequence comes news about Federal Machine and Welder Co.'s new bench-type combination spot and projection welder (R-824) for welding mild steel, stainless steel and aluminum. A design improvement is a low-inertia rubber head with micro-switch firing. The 30-kva. transformer, contained within the frame, has six steps of heat regulation.

Another late release from Eutectic Welding Alloys Corp. tells about a new steel electrode known as EutecTrode 66 AC and 660 DC (R-825). EutecTrodes, like the company's EutecRods described on page 15, weld at low base metal heat, so that preheating is unnecessary. The new electrode can be used for all types of steel—low-alloy, high-carbon, cold drawn and heat resistant.

Addresses of Manufacturers

Acet-A-Tip Co. (R-781)
5069 W. Madison St.
Chicago 44, Ill.

Air Reduction Sales Co. (R-747, 750, 754, 779, 787, 796, 805)
60 East 42nd St.
New York 17, N. Y.

Al-Fin Corp. (R-775)
190 Jamaica Ave.
Hollis 7, N. Y.

Alloy Rods Co. (R-757)
York, Pa.

All-State Welding Alloys Co. (R-778, 804, 807, 808)
96 West Post Rd.
White Plains, N. Y.

Alpha Metals, Inc. (R-811)
363 Hudson Ave.
Brooklyn, N. Y.

Aluminum Co. of America (R-677)
801 Gulf Bldg.
Pittsburgh 19, Pa.

Aluminum Solder Corp. (R-806)
10 East 52nd St.
New York 22, N. Y.

American Manganese Steel Div.
American Brake Shoe Co. (R-771)
Chicago Hts., Ill.

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meeting, Tulsa, Okla., Oct. 7 to 9, 1946.)

6-120. Mechanical and Metallurgical Control of Sulphuric Acid Corrosion in Petroleum Processes. E. R. Wilkinson. *Corrosion*, v. 3, May 1947, p. 252-262.

Basic factors which influence the degree of sulphuric acid corrosion; some of the mechanical and metallurgical means for affecting systematic control. (Presented at the A.S.-M.E. meeting in Tulsa, Okla., Oct. 7 to 9, 1946.)

6-121. Galvanic Aluminum Anodes for Cathodic Protection. R. B. Hoxeng, E. D. Verink, and R. H. Brown. *Corrosion*, v. 3, June 1947, p. 263-274.

Progress made in the development of galvanic aluminum anodes and service data on their use for the cathodic protection of underground steel structures. 10 ref. (Presented at Annual Meeting of National Association of Corrosion Engineers, Chicago, April 7 to 10, 1947.)

6-122. Corrosion and Preventive Methods in the Katy Field. R. C. Buchan. *Corrosion*, v. 3, June 1947, p. 275-290.

Use of plastic-coated steel and use of a neutralizing agent have been found helpful. The chemicals tried as inhibitors were unsatisfactory. Others are being tried. (Presented to Division of Production, American Petroleum Institute, Chicago, Nov. 13, 1946.)

6-123. Corrosion of Refinery Equipment—A Review. E. E. Kerns. *Corrosion*, v. 3, June 1947, p. 291-294.

Effects of the crude; hydrogen sulphide and mercaptan sulphur; total chloride content (total salt); total sulphur; neutralization. (Presented at A.S.M.E. meeting, Tulsa, Okla., Oct. 1946.)

6-124. Discussion of Paper on Designing to Prevent Corrosion. F. N. Speller. *Corrosion*, v. 3, June 1947, p. 299-300.

Discussion of paper by Mears and Brown, in March issue. Importance of cleanliness as a factor in promoting uniformity of attack.

6-125. Attenuation of Drainage Effects on a Long Uniform Structure With Distributed Drainage. J. M. Standring. *Corrosion*, v. 3, June 1947, p. 301-309.

A mathematical development. (Paper presented at meeting of National Association of Corrosion Engineers, Chicago, April 7 to 10, 1947.)

6-126. Combatting Corrosion by Rust. Joseph Kalmer. *Canadian Metals & Metallurgical Industries*, v. 10, May 1947, p. 38, 40.

The cost of rust in underground pipes. How rusting occurs. Bacteria which cause rust. (Research work being done by British scientists.)

6-127. Corrosion of Filters in Sugar Refineries. Part I. H. Inglesent and J. Anderson Storrow. *Industrial Chemist*, v. 23, May 1947, p. 291-297.

Results of investigations using plant liquors. Losses due to contamination; selection of materials; behavior of different alloys; corrosion with glucose liquors.

6-128. Corrosion Resisting Steel for Marine Conditions. *British Steelmaker*, v. 13, May 1947, p. 258.

Results of exposure tests on a copper-bearing steel made by a British firm.

6-129. A Study of the Cause of Hard Slag Deposits on Firesides of Naval Boilers. L. C. McCloskey. *Journal of the American Society of Naval Engineers*, v. 59, May 1947, p. 146-164.

A study of a type of deposit on superheating tubes which has caused much trouble in the Navy. The chemical and physical nature of the deposits; fuel and boiler design characteristics; burner design; theoretical considerations concerning atomization and behavior of small particles in gas streams and films; the probable sequence of events in slag formation; the cause of slagging; means for reducing the incidence of slag formation; and methods for removal of deposits.

6-130. Cast Alloys Stabilized With Columbium or Titanium. E. A. Schoefer. *Alloy Casting Bulletin*, May 1947, p. 1-7.

The influence on corrosion resistance of columbium and titanium additions to CF-type chromium-nickel alloys, given in report submitted to Alloy Casting Institute by Battelle Memorial Institute.

6-131. Estimation of Scaling Resistance. Howard S. Avery. *Alloy Casting Bulletin*, May 1947, p. 9-12.

Nomographs prepared by Battelle Memorial Institute for use in estimating the approximate corrosion resistance of iron-nickel-chromium alloys to oxidizing or reducing (flue-gas) atmospheres at elevated temperatures.

6-132. Corrosion Processes. (Concluded.) U. R. Evans. *Metal Industry*, v. 70, May 16, 1947, p. 355-357.

Review of British work. 40 ref.

6-133. Use of Glycerine in Metal Protection. Georgia Leffingwell and Milton A. Lesser. *Corrosion and Material Protection*, v. 4, May-June 1947, p. 12, 22.

A review. 43 ref.

6-134. Relation Between Corrosion Rate of Copper-Lead Bearing Alloys and Pure Lead in Solutions of Organic Acids in Hydrocarbons. Carl F. Prutton and David Turnbull. *Corrosion and Material Protection*, v. 4, May-June 1947, p. 13-18, 20.

Rate of corrosion of two types of copper-lead bearing alloys in air-saturated solutions of various organic acids in xylene and white oil. Several variables were controlled and evaluated. 10 ref.

For additional annotations indexed in other sections, see:
4-61; **7**-210-216-224; **23**-164.

7 CLEANING & FINISHING

7-195. The Electrolytic Polishing of Metals in Research and Industry. R. W. K. Honeycombe and D. S. Kemsley. *Commonwealth of Australia, Council for Scientific and Industrial Research, Melbourne, Serial No. 150*, March 5, 1947, 29 p.

The theory of electrolytic polishing and a survey of methods used in the laboratory and in industry. 62 ref.

7-196. Production Processes. Their Influence on Design. Part XXIII. Roger W. Bolz. *Machine Design*, v. 19, May 1947, p. 131-139.

Barrel finishing of machined parts requires less time and results in superior finish.

7-197. Three Scuff-Resistant Coatings for Ferrous Wearing Surfaces. *SAE Journal*, v. 55, May 1947, p. 42-43.

Some specific applications of manganese iron phosphate coating, iron oxide coating, and caustic-sulphur coating. (Based on paper "Scuff and Wear Resistant Chemical Coatings," by F. C. Young and B. B. Davis.)

7-198. Barrel Finishing of Metal Products. Part IX. H. Leroy Beaver. *Products Finishing*, v. 11, May 1947, p. 46-48, 50, 52, 54, 56.

The relationships of barrel finishing and polishing in general production.

7-199. Finishing Clinic. Allen G. Gray. *Products Finishing*, v. 11, May 1947, p. 58-59, 62, 64, 66, 68, 70, 74, 76, 78.

Factors to be considered in cleaning of aluminum; selection and application of clear metal lacquers; continuous spray cleaning and pickling for porcelain enameling and infrared baking; latex-dip coatings; determination of thickness of tin coatings on copper and brass.

7-200. Cleaning and Finishing Vacuum Cleaner Parts. Sanford Markey. *Products Finishing*, v. 11, May 1947, p. 80, 82, 84, 86.

A unique washing technique plus infrared drying used by the P. A. Geier Co., Cleveland.

7-201. Production Finishing Equipment Featured in Experimental Laboratory. *Products Finishing*, v. 11, May 1947, p. 92, 94, 96, 98.

Testing laboratory operated by Newcomb Detroit Co. Policy is to provide facilities for interested manufacturers to conduct their own tests.

7-202. New Anticorrosive Finish Gives 20 Years' Protection. *Iron Age*, v. 159, May 22, 1947, p. 76, 152.

New coating developed to protect ferrous metal surfaces from atmospheric corrosion is claimed to afford protection to metals exposed to severe weathering conditions, for a period of 20 years or more without further application. It can be applied cold by brushing, spraying, or dipping; sets up in a short time and can be pigmented, painted, or plated.

7-203. The Electrolytic Polishing of Metals. Part I. Electrolytic Polishing of Copper in Orthophosphoric Acid. *Council for Scientific and Industrial Research, Physical Metallurgy Report No. 9*, Sept. 9, 1946, 7 p.

Results of a study of the mechanism of the above electropolishing process.

7-204. Finishing Steel for Decorative and Protective Purposes. Reid L. Kenyon. *American Iron and Steel Institute Preprint*, 1947, 28 p.

Developments in nonmetallic finishes, electroplated and hot-dip metallic coatings, combined metallic and nonmetallic coatings, porcelain enamels, stainless steel, and special finishes.

7-205. The Metallizing of Glass and Plastics by the Reduction of Aqueous Solutions. Patrick B. Upton. *Journal of the Electrodepositors' Technical Society Reprint*, v. 22, 1947, p. 45-72.

The more important of the older processes, together with new modifications, and attempts to collate the new methods or techniques now being employed or developed. Preparation of the surface to be metallized; silvering processes and their application; use of metals other than silver; use of the metal film as a basis for electrodeposition.

7-206. Coats Make the Product. Charles A. Breskin. *Scientific American*, v. 176, June 1947, p. 256-258.

Application of plastic coatings to metals, paper, and leather.

7-207. Scottish Firm Installs Plant for Cast Iron Porcelain Enameling. *Enamelist*, v. 24, May 1947, p. 29-31.

Plant and equipment.

7-208. Infrared Sheds New Light on Low-Cost Drying. *Modern Industry*, v. 13, May 15, 1947, p. 81-82, 84, 86.

Examples of its diversified use.

7-209. Electropolishing Silver to Reduce Finishing Costs. Daniel Gray and S. E. Eaton. *Metal Finishing*, v. 45, May 1947, p. 60-61, 65.

Production-line methods using alkaline-cyanide baths now in use for finishing of silver by Oneida, Ltd.

7-210. Application of Metallic Coatings. Rick Mansell. *Metal Finishing*, v. 45, May 1947, p. 62-65.

A survey of corrosion, cleaning and pickling, polishing methods, and electrodeposition processes for metallic coatings. (To be concluded.)

7-211. Electrostatic Spraying of Porcelain Enamel. Richard E. Helmuth. *Steel Processing*, v. 33, May 1947, p. 281-284.

The techniques used, and the advantages of the method over conventional processes.

7-212. Exhaust Unit for Fume Suppression. *Iron Age*, v. 159, May 29, 1947, p. 63.

An exhaust unit for suppressing obnoxious gases from lead baths, pickling tanks, galvanizing tanks, plating tanks, nitriding furnaces and spray-cleaning booths in which cleaning solvent is used.

(Turn to page 22)

Welding Equipment Manufacturers

(Continued from page 19)

Ampco Metal, Inc. (R-742, 745, 764, 765)
1745 S. 35th St.
Milwaukee 4, Wis.

Arcos Corp. (R-763, 783)
1515 Locust St.
Philadelphia 2, Pa.

Aronson Machine Co. (R-814)
Arcade, N. Y

Banner Products Co. (R-720, 728)
4960 N. 29th St.
Milwaukee 9, Wis.

Cesco Products Co. (R-699, 782)
30 N. LaSalle St.
Chicago 2, Ill.

Champion Rivet Co. (R-773)
Cleveland 5, Ohio

Division Lead Co. (R-810)
836 W. Kinzie St.
Chicago 22, Ill.

Eisler Engineering Co. (R-722)
740 S. 13th St.
Newark 3, N. J.

Electric Arc, Inc. (R-819)
152 Jelliff Ave.
Newark 8, N. J.

Electric Furnace Co. (R-794, 795)
Salem, Ohio

Electrical Engineering Co. (R-700)
335 Lemcke Bldg.
Indianapolis, Ind.

Electronic Products Co. (R-738)
P. O. Box 74
North Aurora, Ill.

Eutectic Welding Alloys Corp.
40 Worth St. (R-776, 825)
New York 13, N. Y.

Federal Machine & Welder Co.
Warren, Ohio (R-710, 711, 824)

Garfield Engineering Corp. (R-815)
Kansas City, Mo.

Garibay Mfg. Co. (R-695)
Montebello, Calif.

Gaso Equipment Co. (R-791)
3253 N. Kedzie Ave.
Chicago 18, Ill.

General Electric Co. (R-676, 683, 692, 733, 734, 739, 749, 753, 762)
Schenectady 5, N. Y.

Gouran, Mark F. (R-813)
7426 Devon St.
Mt. Airy, Philadelphia, Pa.

Handy & Harman (R-798)
82 Fulton St.
New York 7, N. Y.

Harnischfeger Corp. (R-684, 751)
Milwaukee, Wis.

Hobart Brothers Co. (R-685, 686,
Troy, Ohio 687, 688, 689, 821)

Hoffman Co., Robert W. (R-726)
Chicago, Ill.

Industrial Overlay Metals Corp.
422 S. Michigan Ave. (R-772)
Chicago 1, Ill.

Keaton Mfg. Co. (R-743)
Box 202
Butler, Wis.

Lacey-Webber Co. (R-694)
Kalamazoo, Mich.

Lake Chemical Co. (R-809)
607 N. Western Ave.
Chicago 12, Ill.

Larkin Lectro Products Co. (R-715)
New York 30, N. Y.

Lincoln Electric Co. (R-682, 690, 691, 756)
12818 Coit Rd.
Cleveland 1, Ohio

Linde Air Products Co. (R-678, 681,
30 East 42nd St. 777, 784, 785, 786)
New York 17, N. Y.

Liquid Carbonic Corp. (R-788)
3100 S. Kedzie Ave.
Chicago 23, Ill.

Mallory Co., P. R. (R-744)
Indianapolis, Ind.

Martin Wells Co. (R-698)
5886 Compton Ave.
Los Angeles 1, Calif.

McCauley Alloy Sales Co. (R-797)
407 S. Dearborn St.
Chicago 5, Ill.

McFerron-Myers Products Co. (R-818)
308 Euclid Ave.
Cleveland 14, Ohio

McKay Co. (R-769)
1005 Liberty Ave.
Pittsburgh 22, Pa.

Metal & Thermit Corp. (R-746)
120 Broadway
New York 5, N. Y.

Metron Instrument Co. (R-731)
432 Lincoln St.
Denver 9, Colo.

Miller Electric Mfg. Co. (R-679)
Appleton, Wis.

Mine Safety Appliances Co. (R-822)
Braddock, Thomas and Meade Sts.
Pittsburgh 8, Pa.

Morton Mfg. Co. (R-820)
Broadway and Hoyt
Muskegon Hts., Mich.

National Cylinder Gas Co. (R-766)
205 W. Wacker Dr.
Chicago, Ill.

National Electric Welding Machines Co.
Bay City, Mich. (R-704)

National Lead Co. (R-812)
111 Broadway
New York, N. Y.

Ohmstede Machine Works (R-790)
897 N. Main St.
Beaumont, Texas

Page Steel & Wire Div. (R-752)
American Chain & Cable Co.
Monessen, Pa.

Photoswitch, Inc. (R-730)
77 Broadway
Cambridge 42, Mass.

Pier Equipment Mfg. Co. (R-714)
Milton & Cross Sts.
Benton Harbor, Mich.

Plymouth Equipment & Supply Co.
P. O. Box 358 (R-697)
Plymouth, Mich.

Precision Welder & Machine Co.
Cincinnati 10, Ohio (R-709)

Progressive Welder Co. (R-702, 703, 707, 716, 723, 725)
3050 E. Outer Drive
Detroit 12, Mich.

Ransome Machinery Co. (R-816)
Industrial Division
Dunellen, N. J.

Rapidesign, Inc. (R-823)
P. O. Box 592
Glendale, Calif.

Raytheon Mfg. Co. (R-721)
Waltham, Mass.

Reid-Avery Co., Inc. (R-767
Dundalk, Baltimore 22, Md.

Rex Welder & Engineering Co.
7 East 19th St. (R-719, 729
Kansas City, Mo.

Sciaky Brothers, Inc. (R-706, 724
4915 W. 67th St.
Chicago 38, Ill.

Scientific Research Co. (R-789
1618 N. Vancouver Ave.
Portland 12, Ore.

Sherman & Co. (R-799, 800, 80
197 Canal St. 802
New York 13, N. Y.

Smith Corp., A. O. (R-760
Milwaukee, Wis.

Smith & Sons, G. W. (R-701
5400 Kemp Road
Dayton 3, Ohio

Square D Co. (R-732, 735, 736
Industrial Controller Div.
4041 N. Richards St.
Milwaukee 12, Wis.

Stoody Co. (R-770
Whittier, Calif.

Taylor-Hall Welding Corp.
(See Federal Machine & Welder Co.

Taylor-Winfield Corp. (R-708
1052 Mahoning Ave.
Warren, Ohio

Thomson Electric Welder Co. (R-70
Lynn, Mass. 713, 717

Tweco Products Co. (R-693
Wichita 1, Kan.

Universal Welder Corp. (R-727
745 Carnegie Ave.
Cleveland 15, Ohio

Vangtronic Corp. (R-718
87 Washburn St.
Bridgeport, Conn.

Victor Equipment Co. (R-680
844 Folsom St.
San Francisco, Calif.

Victory Engineering & Machine Work
3000 Chouteau (R-817
St. Louis, Mo.

Wall Colmonoy Corp. (R-774
19345 John R St.
Detroit 3, Mich.

Weiger Weed and Co. (R-741
Detroit 14, Mich.

Welder Mfg. Co. (R-793
Milwaukee 3, Wis.

Weldex, Inc. (R-712
7306 McDonald Ave.
Detroit 10, Mich.

Welding Engineering Co. (R-696
264 E. Ogden Ave.
Milwaukee 2, Wis.

Welding Equipment & Supply Co.
223 Leib St. (R-803
Detroit 7, Mich.

Weldit, Inc. (R-780
994 Oakman Blvd.
Detroit 6, Mich.

Weltronic Co. (R-737
Detroit 19, Mich.

Westinghouse Electric Corp. (R-74
P. O. Box 1017 758, 759, 792
Pittsburgh 30, Pa.

Wilson Welder & Metals Co. (R-74
60 E. 42nd St. 755, 761, 768
New York 17, N. Y.

7-213. Plastic Film Cuts Spray Booth Stripping Costs. *Iron Age,* v. 159, May 29, 1947, p. 69.

Time cut from 2 hr. to 5 to 10 min. Coating is applied to clean walls with standard spray guns to a thickness of 0.002 to 0.005 in. No greasing or other preparation is required. To remove the coating, a corner is broken with a putty knife and the accumulations are peeled off in large chunks.

7-214. Protective Coatings Under Test. *Chemical Engineering,* v. 54, May 1947, p. 154-155.

Cooperative test program of Sherwin-Williams and Dow Chemical Co. being conducted at the latter's Freeport, Texas, plant. Test panels are exposed to air laden with both marine salts and miscellaneous chemical fumes.

7-215. Materials for Wire-Wound Resistors—Some Recent Developments. Edward E. Marbaker. *Materials & Methods,* v. 25, May 1947, p. 83-88.

Silicone coatings found to be most satisfactory for resistance units which had to withstand diverse and destructive heat and atmospheric conditions. Form consists of a ceramic or other insulating core wound with resistance wire, the ends of which are attached to band and tab or ferrule terminals.

7-216. Chemically Generated Film Aids in Corrosion Control. *Steel,* v. 120, June 2, 1947, p. 101-102, 144.

Latest developments in a method that converts the surface of zinc or cadmium into a complex chromate.

7-217. Developments in the Application of Gas Infrared Heating to Metal Finishing. J. B. Carne. *Sheet Metal Industries,* v. 24, May 1947, p. 989-992, 998.

Equipment available; heat needed; types of finishes to which it may be adapted.

7-218. Vitreous Enameling Spraying Technique in Enamel Application. A. J. Biddulph. *Sheet Metal Industries,* v. 24, May 1947, p. 1005-1008, 1013.

Equipment; types of gun; containers for enamel; spray booths; exhaust and dust extractions; method of spraying; recent developments. (A paper presented at meeting of the Institute of Vitreous Enamellers.)

7-219. Modern Wire Pickling Practice and Plant Design. Part I. Edward Mulcahy. *Wire Industry,* v. 14, May 1947, p. 269-271.

British practice. (To be continued.)

7-220. Specialized Enamel Plant Production—Bathtubs and Sinks. Harry B. Richardson. *Finish,* v. 4, June 1947, p. 15-17.

Operations at Newark Enameling Corp., Bloomfield, N. J. Production process takes only 2 hr.

7-221. Lithium Compounds in Porcelain Enamel Compositions. Part I. Paul A. Huppert. *Finish,* v. 4, June 1947, p. 18-21, 60.

Past work on the subject of lithium in enamels, and results of an investigation into the merits of certain new types of ground-coat enamels using lithium manganite and lithium cobaltite.

7-222. Enamel Division Program Report—American Chemical Society Forty-Ninth Annual Meeting. *Finish,* v. 4, June 1947, p. 29-31, 34-35, 38-39, 41, 52-56, 62.

Authors' resumes of the following papers: The mechanism of fracture in porcelain enamels, by Paul L. Smith. The effect of chemical preoxidation of steel in promoting the adherence of cover-coat enamels, by H. S. Saunders. Suppression of radiations at high temperatures by means of ceramic coatings, by D. G. Bennett. Effect of firing treatment of ground coats on quality of dry process enamels for cast iron, by R. R. Danielson and J. H. Koenig. Determination of compression present in porcelain enamel on sheet iron, by E. E. Bryant and M. G. Ammon. Measurement of enamel slip consistency by means of the Brookfield viscosimeter, by E. M. Oliver. The determination and effect of sulphur gases in plant atmospheres, by B. J. Sweg and M. J. Bozsin. The effect of variations in color stains on the colors produced in porcelain enamels, by Ralph L. Cook and Robert W. Pelz. Refractory ceramic base coats for metal, by W. J. Plankenhorn. The effect of composition on the properties of titanium enamels, by A. L. Friedberg, F. A. Petersen, and A. I. Andrews.

7-223. The Use of Metallic Pigments in the Preparation of Protective Paints. J. E. O. Mayne. *Journal of the Society of Chemical Industry,* v. 66, March 1947, p. 93-95.

Satisfactory metallic pigments for coating of steel must contain metals less noble than iron and the particles must be in metallic contact with each other and also with the steel. Of the group studied—aluminum powder, zinc dust, and magnesium powder—only zinc dust is said to fulfill the latter condition.

7-224. The Attack of Molten Zinc on Steel in Hot Dip Galvanizing. Heinz Bablik. *Metal Treatment,* v. 14, Spring 1947, p. 29-35.

Structure of the coatings formed in relation to the pre-existing structure of the basis steel. Certain analogies are found between the attack by molten zinc and by sulphuric acid. Surface decarburization is believed to be important in determining the structure of the coatings.

7-225. Factors to Consider in Galvanizing With Gas. A. D. Wilcox. *Industrial Gas,* v. 25, May 1947, p. 15-17, 26-30.

An illustrated discussion.

7-226. Production Metallizing Solves the Problem of Protecting the Welded Seam in Steel Barrels and Drums. *Industrial Gas,* v. 25, May 1947, p. 21.

A production setup designed to apply economically a coating of electrolytic zinc to the area adjacent to the longitudinal welded seam.

7-227. Spraying Color on Parts of Plated Ornaments. George Hilfinger. *Industrial Finishing,* v. 23, May 1947, p. 47-50, 52.

How precision masks are used to guide sprayed colors into certain depressed areas of chromium plated ornaments.

7-228. Conveyerized Cleaning, Spraying and Infrared Drying Layout. Fred M. Burt. *Industrial Finishing,* v. 23, May 1947, p. 54-56, 58, 60.

Layout of equipment for cleaning, spray-painting, and drying metal parts for space heaters.

7-229. Better Spray Painting of Metal Products. C. Raymond Syer. *Industrial Finishing,* v. 23, May 1947, p. 63, 66, 68, 70, 72, 74, 79, 81.

Recommended techniques.

7-230. Protective and Decorative Finishes for Cast Aluminum. John J. Stobie, Jr. *Modern Metals,* v. 3, May 1947, p. 14-19.

Mechanical, chemical, organic and electrolytic finishes. 27 ref.

7-231. Scale Removal and Surface Preparation With Sodium Hydride. H. L. Alexander. *Iron and Steel Engineer,* v. 24, May 1947, p. 44-51; discussion, p. 51.

Historical background; status in industry; chemistry in the bath; testing; treating cycle; equipment; raw materials; placing unit in operation; operating precautions; applications.

7-232. Flame Spraying of Metals and Plastics. *Paint Manufacture,* v. 17, May 1947, p. 154-156.

Recent developments using the powder process.

7-233. Electrical Properties of Paint Films on Metals. F. Wormwell and D. M. Brasher. *Nature,* v. 159, May 17, 1947, p. 678-679.

Results obtained for several paint systems show that there is a characteristic fall in potential during the first few hours. After an intervening period of somewhat fluctuating potential, there is a rise to a maximum with a final decline. An investigation of apparent ohmic resistance and the apparent capacity of the paint film showed that capacity changes are roughly parallel to the approximate area covered with rust.

For additional annotations indexed in other sections, see:
3-146; **6**-115-117-122; **8**-81; **11**-61-65-66; **15**-17-18; **16**-79; **20**-263; **22**-255; **23**-164-173; **25**-82; **26**-72.

8 ELECTROPLATING

8-79. Plating Methods at Gerity-Michigan Plant. W. T. Walsh. *Products Finishing,* v. 11, May 1947, p. 28-30, 32, 34, 36, 38, 40, 42, 44.

Plating and materials-handling techniques at Gerity-Michigan Die Casting Co. plants in Detroit and Adrian, Mich.

8-80. Factors Affecting the Distribution of Electrodeposits. N. A. Tope. *Journal of Electrodepositors' Technical Society Preprint,* v. 22, 1947, p. 29-44.

Factors affecting primary current distribution; influence of surface condition; methods of modifying current distribution; effect of gas evolution; influence of specific conductivity of materials; influence of anode distribution; electrochemical factors; effect of metal ion concentration; factors affecting deposition potentials; use of strikes; effect of addition agents and contaminants; bright and alloy plating. 16 ref.

8-81. Discussions. *Journal of the Electrodepositors' Technical Society Preprint,* v. 21, 1946, p. 265-267.

Ten papers published by the Society during 1946 are discussed. They were concerned with: electrodeposition of speculum and of Sn-Zn alloys; determination of thickness of chromium deposits on nickel; electrogalvanizing of wire; electropolishing methods and applications; electroplating on aluminum; and plating solution defects and their remedies.

8-82. P.R. Plating—A New Tool for Electroplaters. George W. Jernstedt. *Westinghouse Engineer,* v. 7, May 1947, p. 89-92.

Periodic-reverse-current electroplating utilizes reversal of the plating current under specified optimum timing conditions. Photomicrographs show the superior quality of the plate obtained as compared with d.c. electroplating.

8-83. Practical Methods in Heavy Industrial Nickel Plating. E. J. Roehl. *Metal Finishing,* v. 45, May 1947, p. 56-59, 71.

Physical properties; cleaning; etching; adhesion; deposition rate; plating baths; antipitting agents; metal distribution control; machining; applications.

8-84. Metallography for the Electroplater. (Concluded.) Alex Blazy and J. B. Mohler. *Metal Finishing,* v. 45, May 1947, p. 68-71.

Techniques and procedures for the common metals and alloys.

8-85. Rectifiers for Electroplating. Part III. Louis W. Reinken. *Metal Finishing,* v. 45, May 1947, p. 72-74, 77.

Theory of parallel and series connections; variable voltages; parallel operation.

8-86. New Spray-Trapping Device. *Light Metals,* v. 10, May 1947, p. 232-233.

Polystyrene tubes, closed at each end to resemble miniature pillows, are floated on chromium-plating baths in

(Turn to page 24)

Filler & Base Metal Must Be Similar in Soldering, Brazing

Reported by E. M. Sherwood

Metallurgist, Sperry Gyroscope Co.

The sixth talk in the "Fabrication of Metals" series of the New York Chapter ⊕ was entitled "Assemblies by Soldering and Brazing". It was given by F. J. Biondi of the Bell Telephone Laboratories.

The nature of the metals to be joined must be considered in relation to the filler metals and alloys—their thermal expansivities, thermal capacities, alloying tendencies, intergranular penetration, impurity contents, and purity of atmospheres and method of attaining and controlling them. In design of the assembly, such factors as clearance, finishes, and location in relation to strength and filler penetration must be considered. Mr. Biondi listed the uses, advantages and disadvantages of the tin-lead alloys, and described the addition agents for tin-lead, copper, brasses, silver, silver-copper and silver-copper-zinc primary alloys.

Wire, foil, slugs, electroplate, molten spray, powders and pastes are used to apply the filler materials. The speaker reviewed the pros and cons of each, and described the formation of interfacial alloys, their strength and electrochemical behavior. In talking about flux for soldering and brazing, he pointed out the advantages of the eutectic $ZnCl_2$-NH_4Cl mixture.

Finally, in discussing methods of evaluating joining systems, the speaker reviewed and presented data obtained by Earle in England from his "Kollagraph" method, and from the twisted wire method developed by Schumacher, Bouten and Phipps of Bell Telephone.

Old-Timers Honored

Some of the "Old-Timers" Honored at the 28th Annual Meeting of the Northwest Chapter on May 8 Are, Left to Right, Sidney J. Pfaff, R. L. Dowdell, Alexis Caswell (Who Has Served as Secretary-Treasurer of the Chapter Since Its Organization), J. D. Mooney and Geo. C. Priester. Other 25-year members who were guests of honor are A. E. Anderson, Wm. S. Getchell, W. E. Johnston, T. L. Joseph, Wm. I. Sweet, Henry H. Wade, D. Tissing, and E. O. Wistrand. John Ford, newscaster for WTCN, was the speaker of the evening on "Some of the Digs and Divots Behind the Mike"

The Reviewing Stand

ONE OF THE MOST surprising facts that came out of the recent poll taken of *Metals Review* readers was that of those that get it, 99.3% read it! And of this Ivory soap figure, 83.9% read it regularly and only 15.4% occasionally. Any publisher would love those figures.

The next two questions we asked brought replies that also smoothed the furrowed editorial brow—in spite of a strange paradox. We asked if the Review of Current Metal Literature was helpful. 89.4% said yes, and 8.3% said no. We asked "Do you refer to it?" 44.1% said regularly; 47.3% said occasionally; and only 5.9% said not at all. Well, that's fine too. But here's the paradox: 91.4% refer to it either occasionally or regularly, but only 89.4% find it helpful. Apparently our circulation includes a small handful of the world's hopefuls who keep on persisting even though they don't find what they seek on the first tries. More power to them!

Our next two questions had to do with a different editorial department—the "New Products in Review" section, also inaugurated in 1944 at the same time as the Review of Metal Literature. This section is composed of descriptions of new equipment and supplies taken from news releases by the manufacturers. Similar descriptions are published in numerous magazines serving the metal industry.

It was to be expected (we reasoned) that we would get a far less enthusiastic reaction to a feature that is available in other publications. But we didn't reason that *Metals Review* readers want their publication to be what its name implies—sufficient unto itself and all-inclusive—because 87.9% of those questioned said that new product information was helpful and 76.2% wanted more of this type of information. In the words of one commentator: "This department is just as important as the annual Metal Exposition."

Versatile Metallurgist

Technical problems ranging from analysis of bore-hole waters for locomotive supply to re-heat treatment of worn auto crankshafts, with everything from insecticides to ceramics in between, are solved by the so-called metallurgists to the Government of Tanganyicka Territory, East Africa, writes H. G. Burks, who has held that position since last August. There are only two government metallurgists in the territory —Mr. Burks and S. H. Harris, his senior on the job. They are considering imprinting on their letterhead the slogan, "The Impossible Done Immediately; the Miraculous Takes a Little Time", but at least he admits that it is difficult to be bored with such a varied and bewildering range of subjects thrown at one daily.

Metals Review can't give him all the answers but it must help! M.R.H.

sufficient depth to blanket the bath and thereby lessen considerably the escape of fine spray.

8-87. Zinc Plating for Corrosion Resistance and Decorative Finishing. W. F. Coxon. *Metal Treatment,* v. 14, Spring 1947, p. 38-40.

Methods used and the future possibilities; the process is likely to prove a serious competitor of cadmium and nickel plating.

8-88. Chromic Acid. *Metal Industry,* v. 70, May 16, 1947, p. 365.

Suggestions for conserving this material in the plating industry.

For additional annotations indexed in other sections, see:
3-146; **7**-204-205-210; **27**-107.

9 PHYSICAL TESTING

9-58. Cast Hardenability Tests. E. W. Pierce. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.,* v. 29, 1946, p. 207-210.

Some of the hardenability work done by various investigators; some of the shortcomings of the present type of test specimens, and need for developing an efficient test method, particularly for intermediate hardening steels.

9-59. New Diamond Hardness Indenter. *Industrial Diamond Review,* v. 7, April 1947, p. 105.

Indenter being made by a French firm for which certain advantages are claimed over the Rockwell indenter and the Vickers pyramid.

9-60. Correlation of Diamond Pyramid and Magnetic Hardness. *Industrial Diamond Review,* v. 7, April 1947, p. 120.

Magnetic hardness is obtained by use of a new instrument called the "Ferroscope". When diamond-pyramid and magnetic-hardness figures are plotted, it is found that the diamond-pyramid hardness increases with magnetic hardness up to a certain point. After this, diamond-pyramid hardness decreases with increase in magnetic hardness. (Abstracted from *Machine Tool Review,* v. 34, May-June 1946, p. 50-52.)

9-61. Testing and Inspection. N. C. Fick. *Metals Review,* v. 20, May 1947, p. 5-8, 47.

Present methods for determining properties of metals, and trends, with notes on the literature.

9-62. Apparatus and Equipment for Testing and Inspection. *Metals Review,* v. 20, May 1947, p. 9-11, 14-15, 17, 19.

1946 developments in testing devices, as described by the manufacturers. Tensile; hardness; fatigue; creep; flaw detection; spectrography; sorting equipment; size inspection.

9-63. Microhardness Testing. *Scientific American,* v. 176, June 1947, p. 265-269.

Instrument which can gage the hardness of a single steel grain at as many as three points within the breadth of a human hair.

9-64. High Temperature Testing. Part I. W. E. Kuhn. *Canadian Metals & Metallurgical Industries,* v. 10, May 1947, p. 20-22, 43.

The effect of high temperature on metals and how to plan an intelligent test program. (To be continued.)

9-65. Microhardness Testing. A. J. Stokes and S. B. Dew. *Automobile Engineer,* v. 37, May 1947, p. 181-186.

Details of a study of the W. 63 (British) aluminum piston alloy. Photomicrographs show effects of different heat treatments and of impressions on different crystal phases.

9-66. Some Aspects of Hot Hardness Testing. K. G. Robinson. *Metallurgia,* v. 36, May 1947, p. 45-46.

Recommended techniques and necessity for standardization.

9-67. Reproducibility of the Single-Blow Charpy Notched-Bar Test. N. A. Kahn and E. A. Imbembo. *ASTM Bulletin,* May 1947, p. 66-74.

Each of seven industrial and government laboratories tested 6 specimens of uniformly stress-relieved, low-carbon, semikilled steel with keyhole-type notches and 6 with the V-type. Six more of each type were sent to the authors' laboratory from each of the cooperating laboratories and were tested there. The results indicate the superiority of the keyhole-notch over the V-notch for the class of steel investigated.

9-68. Constant-Force Fatigue Testing Machine. *Machine Design,* v. 19, June 1947, p. 152.

Machine for fatigue testing sheet materials in flexure.

9-69. Fatigue Testing Machine. B. J. Lazan. *Machine Design,* v. 19, May 1947, p. 123-127.

Below-resonance, centrifugal-force-type fatigue testing machine has inertia-force compensator to insure constancy of the repeated applied force.

9-70. Rockwell Hardness Corrections for Rounds. G. E. Poole and J. Hunt. *Metal Progress,* v. 51, May 1947, p. 775, 776-B.

Experimental program. Nomographs were constructed from curves of hardness on flats vs. hardness on cylindrical surfaces for each of 11 diameters.

For additional annotations indexed in other sections, see:
2-108; **3**-145-146-149-153-156; **6**-115; **17**-56; **24**-160-172; **27**-109.

10 ANALYSIS

10-87. A New Scheme for the Microchemical Analysis of Ferrous Alloys. E. J. Vaughn and C. Whalley. *Journal of the Iron and Steel Institute,* v. 155, April 1947, p. 535-562.

Development of accurate microchemical methods of analysis for extremely small samples of steels and other ferrous alloys. Use is made of absorptiometric methods, whenever possible to complete the determinations. Chemical separations are reduced to the absolute minimum. Precise conditions for the individual determinations of the elements carbon, silicon, phosphorus, sulphur, manganese, nickel, molybdenum, chromium, vanadium, cobalt, copper, tungsten, titanium, and iron are given in full. 17 ref.

10-88. Super-Purity Aluminum. P. Urech. *Metal Industry,* v. 70, May 2, 1947, p. 303-304.

A colorimetric method for determination of element contents in very small amounts is recommended as a standard.

10-89. Rapid Determination of Tin in Copper-Base Alloys. M. Sherman. *Steel,* v. 120, May 19, 1947, p. 102.

Volumetric method employing modifications of Stanreduce. When set up for runs, the time for a determination is well under 25 min. For the amounts of tin usually found in copper-base alloys the results are within less than 0.05% of the true tin content.

10-90. Summary of Questionnaire on Time of Preliminary Tests. J. R. Pigott. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.,* v. 29, 1946, p. 65-67; discussion, p. 67.

Replies of 41 openhearth superintendents regarding the time required for preliminary tests for carbon, manganese, sulphur, phosphorus, and the common alloying elements in steel, using both chemical and spectrographic methods.

10-91. Colorimetric Determination of Phosphorus in Steels. Uno T. Hill. *Analytical Chemistry,* v. 19, May 1947, p. 318-319.

The colorimetric method of Kitson and Mellon is increased in accuracy and extended in scope by use of a blank which eliminates variables caused by temperature changes and differences in composition. A more rapid procedure using sodium molybdate and vanadate is applicable when vanadium is not present. 10 ref.

10-92. Tetraethylenepentamine as a Colorimetric Reagent for Copper. Thomas B. Crumpler. *Analytical Chemistry,* v. 19, May 1947, p. 325-326.

The blue color of the above reagent is independent of the amount of excess amine, is stable, and obeys the Beer-Lambert law. This amine is nonvolatile, practically odorless and colorless, and provides a color reaction with cupric ion which is about 3.5 times as sensitive as ammonia.

10-93. Determination of Metallic Aluminum in Aluminum Pigments. A. Keith Light and Loreen E. Russell. *Analytical Chemistry,* v. 19, May 1947, p. 337-338.

A volumetric procedure in which the dried powder is dissolved in an acid solution of ferric sulphate in an atmosphere of carbon dioxide, and the resulting ferrous sulphate is titrated with standard potassium permanganate.

10-94. Colorimetric Determination of Antimony in Copper-Base Alloys. Albert C. Holler. *Analytical Chemistry,* v. 19, May 1947, p. 353-355.

The sample is dissolved in nitric acid and the antimony and tin hydrous oxides are filtered off and dissolved in sulphuric and hydrochloric acids. Antimony is determined by a colorimetric iodide method.

10-95. Polarographic Characteristics of Vanadium in Oxalate Solutions. James J. Lingane and Louis Meites, Jr. *Journal of the American Chemical Society,* v. 69, May 1947, p. 1021-1025.

The polarography of the several oxidation states of vanadium in oxalate solutions under various conditions. 13 ref.

10-96. Méthode d'Analyse Qualitative des Cations sans Séparations Systématiques. Caractérisations de: Arsenic, Etain, Antimoine, Bismuth. (Methods for Qualitative Analysis of Cations Without Systematic Separations. I. Qualitative Indication of Arsenic, Tin, Antimony, and Bismuth.) G. Charlot and D. Bézier. *Analytica Chimica Acta,* v. 1, March 1947, p. 113-123.

Results of work on improvement of the quantitative method according to which separations are reduced to a minimum, each metal being detected by an independent test. Special attention to detecting small percentages of the element.

10-97. Dosage Rapide du Chrome et du Vanadium. (Rapid Determination of Chromium and of Vanadium.) Lucien Ducret. *Analytica Chimica Acta,* v. 1, March 1947, p. 135-139.

The total chromium plus vanadium content is determined by direct titration in 2 to 3*N* sulphuric acid solution with a ferrous solution in the presence of sulphonated diphenyl amine as an oxidation-reduction indicator. Vanadium is titrated in the same solution after oxidizing by means of a slight excess of permanganate. After destruction of the excess of oxidizing agent with sodium azide, the titration is completed with the ferrous solution in the presence of the same indicator.

10-98. Analysis of Light Alloys Based on Electrical Resistivity. L. Rotherham and J. I. Morley. *Engineering,* v. 163, May 16, 1947, p. 416-418.

A satisfactory method for magne-

(Turn to page 26)

Aircraft Armor Limited by Weight; Tests Described

Reported by Dow M. Robinson

New England Metallurgical Corp.

"Armor Plate for Aircraft" and "Metallurgical Inspection Tests for Armor" were the subjects presented on Young Men's Night at the May meeting of the Boston Chapter. In introducing the speakers, Technical Chairman Fred C. Robertshaw, Jr., metallurgist on aircraft turbine development at General Electric Co., described the early use of armor, dating back to the days of Archimedes.

Alloy armor plate, according to the first speaker, Wm. J. Harris, Jr., National Research Council Fellow at M. I. T., was first introduced by Krupp Works in 1893 as a 0.50% carbon, 3½% nickel, 1½% chromium steel. The finest armor plate now made incorporates both toughness and hardness.

It was the desire of the Aircraft Armor Section of the U. S. Navy to supply complete coverage to the pilot and crew, but weight limitations imposed a compromise in which a certain degree of protection was sacrificed. This compromise was based on studies of enemy fire power and determinations of the best protection to resist the enemy fire with material such as face hardened armor or homogeneous armor.

Aluminum alloy, heat treated, is also used to resist light fragments and certain types of impact. Woven strands of nylon and doron or glass cloth make an excellent protective yet flexible suit of clothing.

Abraham Hurlich, chief of the armor and ammunition branch of the Watertown Arsenal Laboratory, next discussed the development of nonballistic inspection tests to evaluate the resistance of armor to brittle failure and its resistance to spalling under ballistic attack.

Based upon the characteristic difference in appearance between tough and brittle fractures, the so-called fibre fracture test was developed at the Watertown Arsenal for inspection of tank armor during World War II. Fibrous fractures are correlated with the optimum combination of hardness and toughness, maximum impact energy measured by notched-bar impact tests, maximum resistance to cracking or shattering of armor under ballistic attack at low temperatures, and with a tempered martensitic microstructure resulting from through hardening during quenching.

Mr. Hurlich also described the fracture test for steel soundness employed to reveal the presence of laminations, of inclusions, residual piping, and other segregated defects in rolled armor plate, which are responsible for spalling under ballistic attack.

Young Men's Night at Boston Chapter Shows, Left to Right, Abraham Hurlich, One of the Speakers; Fred C. Robertshaw, Jr., Technical Chairman; Morris Cohen of M.I.T.; and Wm. J. Harris, Jr., Another Speaker

Metal Show Extended to Seven Days

The 29th National Metal Congress will be extended to seven days rather than the customary five days, when it opens in Chicago on Saturday, Oct. 18. The Exposition will be open to industrial employees on that date and the following day by invitation only.

The Exposition, which will occupy all of the floor space in the International Amphitheater in Chicago, will continue during the following week, closing officially on Friday, Oct. 24. Technical sessions of the four cooperating societies will be held in the International Amphitheater and in several leading Chicago hotels during the five days starting Oct. 20. Cooperating societies are the American Society for Metals, sponsor of the Congress, the Iron and Steel Division and Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers, the American Welding Society, and the American Industrial Radium and X-Ray Society.

Headquarters for the American Society for Metals will be in the Palmer House and hotel reservation forms have been mailed to all members of the society.

McElfish Defines Metallurgist's Job In Oil Refinery

Reported by H. L. Millar

Assistant Metallurgist, Plomb Tool Co.

The position of metallurgist in an oil refinery was outlined by P. D. McElfish of Kilsby & Harmon, Inc., before the first joint meeting of the Los Angeles Chapters of A.S.M. and the American Society of Mechanical Engineers.

Confining his subject to the selection, application and maintenance of process equipment, Mr. McElfish pointed out that, since most processes in the oil industry are corrosive, a reliable source of accurate corrosion data is important, but in many instances is not available to the manufacturers of equipment.

Oil companies have arrived at the conclusion that chromium steels pay off, Mr. McElfish stated. Steels with chromium up to 9% for tubes in oil heating and process lines have an initial cost five times greater than carbon steel, yet the corrosion rate of carbon steel is 14 times greater than for chromium steel in a unit processing West Texas high-sulphur crude oil.

For equipment such as furnace tube supports that must withstand severe oxidizing conditions and temperatures of 1500 to 2000° F., chromium-nickel steels such as 18-8, 18-12, 24-12, 25-20 and 15-35, with approximately 0.30% carbon, are used.

Surface wear of moving parts such as shaft sleeves in pumps handling oil at 500 to 1000° can be minimized by the use of hard facing alloys. For sulphuric acid, lead, 14% silicon steel, and, more recently, Hastelloy are used.

In conclusion, the speaker reviewed the responsibilities of the metallurgical department. These are *(a)* changes and alterations in metallic equipment; *(b)* routine temperature control of equipment and processes; *(c)* corrosion checks and control; *(d)* evaluation of new materials for possible use in the refinery; and *(e)* solution of problems connected with plant operation.

sium and aluminum in certain British aluminum and magnesium alloys, under circumstances in which spectrographic methods are not sufficiently accurate. (Condensed from paper presented to the Institute of Metals.)

10-99. A Review of Some Recent Applications to Spectrographic Analysis. J. H. Oldfield. *Journal of the Iron and Steel Institute*, v. 156, May 1947, p. 78-80.

Direct-reading methods use a phototube instead of a photographic plate for recording spectral-line intensities. Advantages. A commercial instrument manufactured in the U. S.

10-100. Modern Methods of Gas Analysis. Part IV. The Ambler Portable Apparatus. W. D. Vint. *Metallurgia*, v. 36, May 1947, p. 47-50.

Technique and equipment for works model and precision model. Apparatus has simplicity and little possibility of gas leaks.

10-101. Amperometric Titration. Part III. Use of a Rotating Micro-Electrode. J. T. Stock. *Metallurgia*, v. 36, May 1947, p. 51-54.

This micro-electrode is particularly useful when dissolved oxygen does not interfere so that titration may be carried out in an open vessel.

10-102. A Method for Micro-Spectrography of Metals. Ford R. Bryan and George A. Nahstoll. *Journal of the Optical Society of America*, v. 37, May 1947, p. 311-316.

Qualitative spectrographic analyses of metallic areas of less than 0.05 mm. in diameter can be obtained by means of the equipment and methods described. The apparatus consists of a device for holding a counter electrode and the specimen to be analyzed; an electronic spark generator; and a medium quartz spectrograph. Minute areas such as inclusions, segregations, crystalline phases, surface contaminations, metallic platings, and the extent of metallic diffusion have been successfully analyzed.

For additional annotations indexed in other sections, see:
1-64.

11 INSTRUMENTS Laboratory Apparatus

11-60. How to Detect "Gassing" of Metals by a Quick and Sensitive Test. Richard E. Frank. *Foote Prints*, v. 18, no. 2, 1947, p. 20-21.

Previous work has shown that ferrosilicons should be nongassing for use in welding electrode coatings. A simple qualitative test for determining the stability of ferrosilicon toward sodium silicate.

11-61. Economical Direct Current Source for Electrolytic Etching. J. G. Cutton. *Metal Progress*, v. 51, May 1947, p. 776.

Direct current supply is obtained by rectifying 110-v. a.c. by means of two selenium rectifiers. This gives 90-v. d.c. with no load, which drops to 5 v. when etching samples.

11-62. A Methyl Methacrylate - Silica Replica Technique for Electron Microscopy. A. F. Brown and W. M. Jones. *Nature*, v. 159, May 10, 1947, p. 635-636.

Technique in which methyl methacrylate polymer is formed from the liquid monomer poured over the surface of the specimen. It is applicable to both metallic surfaces and to biological materials.

11-63. Phase Contrast in the Photomicrography of Metals. F. W. Cuckow. *Nature*, v. 159, May 10, 1947, p. 639-640.

Successful applications of phase contrast in the vertical-illumination metallurgical microscope.

11-64. Measurement—Tool of Science and Industry. Hugh L. Dryden. *Instruments*, v. 20, May 1947, p. 435-437.

The purposes to be served in science and industry by measurement and some of the more recent trends in the development of instrumentation.

11-65. Abrasion Analysis of Protective Coatings. L. S. Barker. *Light Metal Age*, v. 5, May 1947, p. 25.

Technique employed to determine effectiveness of various coatings for aluminum and magnesium.

11-66. Heat Testing of Aluminum Coatings. S. H. Philips. *Light Metal Age*, v. 5, May 1947, p. 26.

In order to protect aluminum alloys used in superspeed aircraft from the bad effects of high temperatures caused by air friction, coatings must be investigated for their heat absorption properties. Technique for evaluating this property.

11-67. A Remote Control Switch for Rocking Electric Melting Furnaces. R. J. Lean. *Machinery (London)*, v. 70, May 1, 1947, p. 457-462.

New instrument uses some unusual mechanical arrangements to provide the necessary control and a special testing and recording mechanism for checking the operation of new control instruments.

11-68. High-Temperature X-Ray Diffraction Apparatus. Alvin Van Valkenburg, Jr., and Howard F. McMurdie. *Journal of Research of the National Bureau of Standards*, v. 38, April 1947, p. 415-418.

A furnace for obtaining X-ray powder-diffraction patterns of sample at elevated temperatures. This furnace is used with the Norelco X-ray spectrometer, in which the photographic film is replaced by a Geiger counter. The assembly has several advantages over previously described high-temperature X-ray powder-diffraction cameras. Diffraction data for the alpha form of $2CaO \cdot SiO_2$.

For additional annotations indexed in other sections, see
2-116; 7-199; 8-84; 20-267; 21-54; 24-145.

12 INSPECTION AND STANDARDIZATION

12-90. Are You Inspecting Correctly? G. E. Campbell. *Industry and Welding*, v. 20, May 1947, p. 26-27, 50, 52, 54.

Stress relieving, magnaflux, X-ray, and radiography standards.

12-91. Aluminum Gages for Ducts. *Heating, Piping & Air Conditioning*, v. 19, May 1947, p. 77.

Equivalent galvanized and aluminum sheet thicknesses for ductwork.

12-92. Million-Volt X-Ray Solves Crankshaft and Other Casting Problems. E. H. Grimm. *Automotive and Aviation Industries*, v. 96, May 15, 1947, p. 36-38, 100.

How Auto Specialties Manufacturing Co. does practically all its radiography of both large and small objects with this unit.

12-93. Refined Techniques for Magnetic Particle Inspection of Welds Presented at Conference. *Steel*, v. 120, May 26, 1947, p. 91, 130.

Reviews papers presented at conference sponsored by Magnaflux Corp., in Chicago, May 8 to 9, 1947.

12-94. Supersonic Testing of Steel. R. R. Webster. *American Iron and Steel Institute Preprint*, 1947, 21 p.

Principles and methods of application; prospects for adoption in the steel industry. Believes that supersonic testing will not only complement X-ray, magnetic-powder testing, etc., but in some cases will supersede them.

12-95. Selection and Application of Statistical Methods to Steel Plant Processing Problems. E. L. Robinson and L. G. Eckholm. *American Iron and Steel Institute Preprint*, 1947, 18 p.

An easy-to-understand explanation beginning with elementary considerations.

12-96. Numerical Classification—A Milestone in Standards Progress. Jno. M. Cannon. *Tool Engineer*, v. 18, May 1947, p. 33-34.

Advantages of the A.S.T.E. numerical index system.

12-97. Three-Dimensional Inspection and Layout of Castings. *Western Metals*, v. 5, May 1947, p. 33.

Method in use by General Electric at Pittsfield, Mass. The layout is projected by a lens directly upon the surface of the casting.

12-98. An Oil-Powder Method of Flaw Detection. Bela Ronay. *Welding Journal*, v. 26, May 1947, p. 407-409.

Navy-developed technique is much more convenient than magnetic-powder, X-ray, or fluorescent-oil methods, especially for difficultly accessible locations, as on diesel-engine frames. Penetrating oil containing a red dye is first applied. After wiping the surface dry, a white powder is dusted on. Any cracks present then appear as red lines on a white background.

12-99. A Comparison of Low-Pressure Vessels Constructed in Compliance With Different Codes or Regulations (With Specific Reference to Liquefied Petroleum Gases). R. E. Cecil. *Welding Journal*, v. 26, May 1947, p. 431-433.

The various codes for construction of compressed gas cylinders—I.C.C. or A.S.M.E.-A.P.I. Cylinders constructed according to either are equally safe.

12-100. Electric Gages in Quality Control. Joseph Manuele. *Electrical Engineering*, v. 66, May 1947, p. 441-444.

A descriptive survey.

12-101. Specifications for Malleable Iron Castings. John E. Linabury. *Foundry*, v. 75, June 1947, p. 84, 224, 226, 228-230.

Practical specifications for each of the important properties of these castings. Points out what the customer should expect and demand, and also where he can reduce his quality requirements without essential loss in serviceability.

12-102. Copper-Beryllium Alloy Castings. *Foundry*, v. 75, June 1947, p. 121-122.

Navy Department Specification 46C11.

12-103. Better Rail-Testing Technique. T. B. Thompson. *Railway Age*, v. 122, May 31, 1947, p. 1126-1128.

Methods and equipment used in detecting the presence of internal defects, with particular reference to the practices and experience of the Illinois Central.

12-104. Magnaflux Machine Permits Continuous Inspection of Heavy-Duty Crankshafts. *Automotive and Aviation Industries*, v. 96, June 1, 1947, p. 52, 82.

New 28-ft. machine at General Motors plant in Pontiac, Mich.

12-105. Charts Help Diagnose Quality Progress. Eugene Goddess. *American Machinist*, v. 91, June 5, 1947, p. 96-100.

Proper use of control charts.

12-106. Sine Bars, Blocks, Plates and Fixtures. *American Machinist*, v. 91, June 5, 1947, p. 155.

Commercial Standard CS 141-47, issued by the Division of Trade Standards, National Bureau of Standards; effective as a voluntary standard of the trade after Aug. 15, 1947.

12-107. Shop Talk on Quality Control. Part II. A. W. Ehlers. *Tool & Die Journal*, v. 13, June 1947, p. 72-74, 140, 142, 144, 146.

A simplified explanation.

For additional annotations indexed in other sections, see:
2-97-109-121; 9-61-62-63; 22-269; 24-165.

(Turn to page 28)

Latest Developments in Heat Treatment Discussed at Regional Meeting

Reported by Walter E. Borin

Metallurgist, Underwood Corp.

The latest developments in the heat treatment of metals were discussed during the technical session of the New England Regional Meeting of the American Society for Metals held in Hartford on May 9. More than 500 metallurgists and ⊕ members from Connecticut, Rhode Island and Massachusetts attended the all-day gathering.

Principal speakers at the afternoon session were William W. Wight, assistant chief metallurgist at Pratt and Whitney Division, Niles-Bement-Pond Co., and secretary-treasurer of the Hartford Chapter; and Harold J. Babcock, research engineer, Ajax Electric Co., Philadelphia. Chairmen at the session were Paul C. Farren of the Springfield Heat Treating Corp. and Russell J. Haigis of the Stanley Works.

Speaking on "The Practical Heat Treatment of High Speed Steel Cutting Tools", Mr. Wight said, "In the last 10 years a great many facts regarding the behavior of high speed steel have been revealed by scientific investigation and research. In general, however, the actual treatment of high speed steel has been altered but slightly and such changes as have been made are in the nature of refinements rather than radical innovations.

"The present-day heat treatment of cutting tools is based," he continued, "both on past practical experience developed through trial and error procedures, and on scientific knowledge of the behavior of the material as advanced by the research laboratories of our universities, steel manufacturers and industrial plants."

Mr. Wight went on to describe the six phases of heat treatment "which can and should be controlled by the heat treater in order to obtain desired results." The six phases he mentioned were the austenizing conditions; rate of heating and cooling; temperature to which work is quenched; tempering; controlled use of isothermal transformation, and surface condition.

Mr. Babcock spoke on "Modern Heat Treating Practices", describing the fundamental principles of salt bath heating and the use of salt as a quenching fluid.

Mr. Babcock also discussed the relation between lower alloy and higher alloy steel in their response in cooling to produce results under different tempering procedures.

Using slides to illustrate his talk, Mr. Babcock showed actual installations of different types of furnaces and the mechanical arrangements for carburizing, tempering and drawing alloy steels and cast iron material.

Lippert Addresses Banquet

A banquet in the evening was addressed by T. W. Lippert, directing editor of *The Iron Age*, who spoke on "Industry in Transition".

Mr. Lippert said that the two factors that have exerted the most influence on this country's present economic condition are the war that ended two years ago, and the resultant responsibilities of the United States as a world power. The first factor has produced a heavy national debt, while the second is costing $900 each year for every person in the United States in aid to the needy in the world and in the costs of occupation.

"This adds up to a terrific burden on industry", he declared, pointing out that the only way to reduce the debt, to pay the costs our world responsibility involves, and to increase the nation's standard of living is "to produce more and better machines and more and better products". By increasing production, he said, the standard of living promised during the war may still be realized.

Plant inspection trips were held during the morning and afternoon to Pratt and Whitney Division of United Aircraft Corp. and to G. F. Heublein and Brothers. The Hartford Chapter was host to the Boston, Worcester, New Haven, and Rhode Island Chapters.

Carburizing Committee Finishes Handbook Work

Six of the nation's foremost authorities on carburizing have completed their preparation of articles for the 1947 Metals Handbook, soon to be published. The ⊕ Committee on Carburizing consists of R. B. Schenck, Buick Motors Division, General Motors Corp., chairman; F. E. Harris of the same company; J. A. Dow, Dow Furnace Co.; H. W. McQuaid, metallurgical consultant; R. G. Peters, Warner Gear Division; and Gordon T. Williams, Pratt and Whitney.

Members of the committee have written eight articles on the various methods of carburizing steel parts. Pack carburizing, liquid carburizing and gas carburizing are discussed and specific recommendations are given for the selection and heat treatment of steels for carburizing. The mechanism of carburizing is described and methods for determining case depth outlined.

At One of the Tables for the Hartford Regional Meeting Are (Left to Right) Haig Solakian, Chief Metallurgist, A. F. Holden Co.; C. F. Hammond, Vice-President, A. F. Holden Co.; Henry Keshian, Metallurgist for Chase Brass and Copper Co.; J. M. Halloran, Manager of the Furnace Division for Holden; A. F. Holden, President of the Company; C. R. Brown, Field Engineer; R. S. Muller, Eastern Representative for Metal Progress *and* Metals Review; *J. E. Donnellan, Field Engineer for Holden; G. L. Richter of Farrel-Birmingham Co.; and W. H. Towner, Another Field Engineer*

13 PYROMETRY Temperature Control

13-23. A Photo-Electric Roof Pyrometer for Openhearth Furnaces. T. Land. *Journal of the Iron and Steel Institute,* v. 155, April 1947, p. 568-576.

Photo-electric pyrometer, employing a selenium barrier-layer photo-electric cell, has been developed for the measurement of openhearth furnace roof temperatures. The reasons are given for choosing a photo-electric instrument in preference to other types of radiation pyrometers. The construction, installation, and operation of the pyrometer, and the errors introduced in the measurements by the presence of flame in the furnace. 12 ref.

13-24. Emissivity of Molten Iron and Steel. D. Knowles and R. J. Sarjant. *Journal of the Iron and Steel Institute,* v. 155, April 1947, p. 577-592.

Emissivity of molten iron and steel has been determined under a wide range of laboratory and workshop conditions. Observations of true temperature were made with immersion thermocouples, and correlated with apparent temperatures indicated by disappearing-filament optical pyrometers. Variations of emissivity were studied in relation to true temperature, the composition of the molten metal, the type of steelmaking process, the character of the lining of either melting furnace or ladle, and the casting conditions. Influence of carbon, silicon, aluminum, chromium, nickel, copper, and manganese content. 12 ref.

13-25. A Radiation Pyrometer for Openhearth Bath Measurements. H. T. Clark and S. Feigenbaum. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.,* v. 29, 1946, p. 229-241; discussion, p. 241-243.

Pyrometer employs a radiation device, mounted inside an open-end steel tube, sighted on the liquid steel. Compressed air keeps the orifice free from molten slag and steel. A convenient method for standardizing the pyrometer. 18 ref.

13-26. Temperature Determination of Molten Metal. G. Vennerholm and L. C. Tate. *American Foundryman,* v. 11, May 1947, p. 56-63.

Various methods tried to measure accurately the temperature of the liquid metal in the furnace and the results of an investigation carried out at the Ford Motor Co.

13-27. Furnace Temperature Control for Large Steam-Generating Units. Otto de Lorenzi. *Blast Furnace and Steel Plant,* v. 35, June 1947, p. 724-729.

Bypass damper provides constant temperature at the superheater outlet. Desuperheaters are used to bring about a reduction in temperature of the superheated steam. Furnace wall cleanliness provides effective absorbing of a large portion of the heat. (Portion of a paper presented at meeting of the American Society of Mechanical Engineers, Dec. 2 to 6, 1946.)

13-28. A Photo-Electric Pyrometer for a Small High-Frequency Induction Furnace. T. Land and H. Lund. *Journal of the Iron and Steel Institute,* v. 156, May 1947, p. 75-77.

Simple pyrometer uses a barrier-layer-type photo-electric cell for measuring the temperature of molten permanent-magnet alloys in a small high-frequency induction furnace. The pyrometer will measure the true temperature of the charge within ±10° C. for certain alloys.

13-29. Steel-Surface Pyrometer Developed by U. S. Steel Research Laboratory. *Industrial Heating,* v. 14, May 1947, p. 786, 788.

Details of new radiation-type instrument for slab-surface temperatures up to 2400° F.

14 FOUNDRY PRACTICE

14-146. Advances in the Foundry Industry. Charles K. Donoho. *Metal Progress,* v. 51, May 1947, p. 765-770.

Wartime changes in foundry practice; how these changes will affect peacetime output, markets, and competitive uses.

14-147. New Molding Technique Improves Cast Crankshaft. *Automotive and Aviation Industries,* v. 96, May 15, 1947, p. 33.

New technique utilizes cooling capacity of the continuous conveyer hangers on which crankshafts are poured in groups of four. The hangers, serving as a base of vertical molds, promote the progressive cooling of the metal from the bottom up so that molten metal can fill in continually the space normally resulting from solidification and consequent shrinking.

14-148. First Aid to a Foundry Problem. *Inco,* v. 21, no. 2, 1947, p. 19, 26.

Use of Monel chaplets (small metal pieces used to support cores for hollow castings).

14-149. Scientific Research and the Canadian Foundry Industry. H. H. Fairfield. *American Foundryman,* v. 11, May 1947, p. 53-55.

Results of a survey of Canadian foundrymen made to determine the most important subjects for research by the Canadian Bureau of Mines' newly established foundry research laboratory.

14-150. Gating Magnesium Alloy Castings. H. E. Elliott and J. G. Mezoff. *American Foundryman,* v. 11, May 1947, p. 71-79.

A new gating method by which some of the problems created by the chemical activity of liquid magnesium alloys have been overcome more economically than when using older gating methods.

14-151. Marketing Preparation of Foundry Sands. Franklin P. Goettman. *American Foundryman,* v. 11, May 1947, p. 80-82.

Important factors in the production of uniform washed sands at Albany, N. Y., and Southern, N. J.

14-152. Liquid Phenolic Resins for Casting Foundry Patterns. C. R. Simmons. *American Foundryman,* v. 11, May 1947, p. 94-96.

The processing and application of accelerated-type liquid phenolic casting resins. Basic uses include, in addition to foundry applications, forming dies for both hydropress and stretchpress operation, assembly jigs and fixtures, checking fixtures, design and working models, plating shields, masking fixtures, and patterns used in duplicating machines.

14-153. Solid and Slush-Type Zinc Alloy Permanent Mold Castings. Herbert Chase. *Iron Age,* v. 159, May 29, 1947, p. 58-63.

Procedure used to produce such castings for use in home floor lamps, covering particularly the making of the molds and pouring and slushing techniques. The economics of this type of casting vs. die casting.

14-154. Saving Foundry Coke. J. A. Bowers. *Foundry,* v. 75, June 1947, p. 72-73, 258-260.

Practical methods for reduction of coke consumption.

14-155. Cores, Sands, and Binders. O. Jay Myers. *Foundry,* v. 75, June 1947, p. 74-75, 192, 194, 196, 200.

Fundamental principles involved in production of satisfactory cores.

14-156. Casting Zinc Alloy Dies. S. Menton. *Foundry,* v. 75, June 1947, p. 76-79, 267-269.

Foundry practice followed by the industry in casting of the above for the making of steel stampings.

14-157. Importance and Future of the Foundry Industry. George T. Christopher. *Foundry,* v. 75, June 1947, p. 85, 160, 163.

The need for increased production of gray iron castings for the automobile industry, in spite of the insistence of foundrymen that they are now operating at capacity. The labor problem of the foundry due to working conditions.

14-158. Should Molds Be Vented? J. Richard Adams. *Foundry,* v. 75, June 1947, p. 86-87, 268-269.

Experience shows that venting is unnecessary.

14-159. Pours Engine Castings in Dry Sand Molds. (Concluded.) Pat Dwyer. *Foundry,* v. 75, June 1947, p. 88-91, 184, 188, 190, 192.

Foundry practice in the Franklin, Pa., plant of the Chicago Pneumatic Tool Co.

14-160. Kansas Manufacturer Builds Modern Gray Iron Foundry. *Iron Age,* v. 75, June 5, 1947, p. 92-93, 232, 234.

Equipment and procedures followed by McNally Pittsburg Foundries, Inc., Pittsburg, Kan.

14-161. Sealing Bronze Pressure Castings Through Heat Treatment. Fred L. Liddell. *Aluminium & the Non-Ferrous Review,* v. 12, Jan-March 1947, p. 2-4, 6.

An investigation of the possibility of sealing gun metal, valve-bronze, and hydraulic-bronze castings by heat treatment. Short-time pressure tests at room temperature indicated that sealing took place on annealing for 3 hr. at 1200 to 1300° F. in an air or oxygen-rich atmosphere. Further work under service conditions is necessary to justify the technique.

14-162. Relative Strengths of Core Binders. Part III. Hiram Brown. *Light Metal Age,* v. 5, May 1947, p. 11-13, 26.

A total of 17 binders of various classes were tested for their relative bonding power, rapidity of baking, and relative cost. Economic considerations. (To be continued.)

14-163. Basic Cupola Practice. Recent Progress and Prospects. Part I. *Foundry Trade Journal,* v. 82, May 1, 1947, p. 7-12.

Desulphurization and dephosphorization of cupola iron and pig iron, giving the results of cooperative work under the auspices of the Technical Council of the Institute of British Foundrymen.

14-164. Basic Cupola Practice. Recent Progress and Prospects. Part II. *Foundry Trade Journal,* v. 82, May 8, 1947, p. 27-32.

Desulphurization and dephosphorization of cupola iron and pig iron in basic-lined ladles. (Presented at meeting of Institute of British Foundrymen, March 19, 1947.)

14-165. Practical Elements of Machine Molding. F. J. Bullock. *Foundry Trade Journal,* v. 82, May 15, 1947, p. 45-49; discussion, p. 49-50.

Technique followed. Machine selection and power. Patterns. (Paper read before the South African branch of the Institute of British Foundrymen.)

14-166. Application of Hydro-Blast to Dressing and Sand Recovery. Part I. Wm. Y. Buchanan. *Foundry Trade Journal,* v. 82, May 22, 1947, p. 69-74.

Use of a wet sand-blast process for the dressing of castings. Description of the recovery of the sand. (Read before the Scottish Branch of the In-

(Turn to page 30)

Six Major Welding Methods Reviewed At Joint Meeting

Reported by Robert B. Wallace

Carnegie-Illinois Steel Corp.

The need for general knowledge of the many different welding processes in use today was stressed by Leon C. Bibber, welding engineer of Carnegie-Illinois Steel Corp., in an address before a joint meeting of the Mahoning Valley Chapter and the Mahoning Section of the American Welding Society on April 8. Mr. Bibber displayed wall charts illustrating all of the factors involved in every known welding process. These charts will be published by the American Welding Society within the next year or so.

In a broad sense, Mr. Bibber said, there are six major methods of welding —forge, thermit, gas, arc, resistance and brazing. Giving the highlights of arc welding, Mr. Bibber told how bare wire made porous welds that had to be calked or rusted for watertightness. Furthermore, nitrogen pickup formed nitride needles in the weld with resultant brittleness.

Welders, therefore, turned to coated rods, which can add desired elements to the weld metal and create a protective gas around it. A wartime development was a lime-coated rod which minimizes underbead cracking by eliminating hydrogen in the weld metal.

In automatic metal-arc welding, the coating acts as a strong insulator, and a number of ingenious ways of inducing current in the rod have been devised.

In atomic hydrogen welding a stream of molecular hydrogen fed between two tungsten electrodes is changed to atomic hydrogen, which protects the weld from the atmosphere. This method gives a smooth, flat weld, and is rapidly gaining favor for thin parts and high-silicon strip. Inert gases such as argon and helium are also used as a shield, particularly on the nonferrous metals.

Forge welding is used in the manufacture of butt and lap welded pipe. Clad metal "sandwiches" up to 32 in. thick have been made, in which the stainless and carbon steel are bonded by the "forge welding" action of the rolls in the rolling mill.

Thermit welding of an irreplaceable 54-in. diameter pinion gear which had broken across the diameter was illustrated by a set of slides. One of the largest thermit welds ever made, it used 9000 lb. of thermit metal. Practically any composition can be obtained in thermit welding, and its terrific heat (estimated to be 4200° F.) assures melting and therefore good bonding.

Spot welding is one of the most versatile processes, since time and temperature are carefully (and easily) controlled. Its uses are extensive and varied.

In conclusion, Mr. Bibber discussed the quenching action of welding, which accounts for the fact that steels of low hardenability are used for most welding operations to avoid a martensite zone. The discussion which followed the lecture centered on the effect of alloying elements (particularly residual alloys) on the various welding properties.

Describes Nuremberg War Criminal Trials

Reported by M. J. Weldon

Henry G. Thompson & Son Co.

A stirring account of the Nuremberg War Criminal Trials, where he served as the chief prosecutor and executive trial counsel under Justice Jackson of the Supreme Court, was presented by Thomas J. Dodd on the occasion of Sustaining Members' Night in New Haven.

Mr. Dodd stressed that the real nature and purpose of the Nuremberg trials is not yet fully understood by citizens of our country. The goal was not retribution, but rather a first step toward the day when all people will live in peace by law. The speaker deplored the fact that two major wars are blots on the record as we near the half-way mark of the Twentieth Century, and urged encouragement of a Federated States of the World having executive power transcending that of individuals.

stitute of British Foundrymen, Royal Technical College, Glasgow. To be continued.)

14-167. The Cupola as a Precision Instrument. R. C. Tucker. *Foundry Trade Journal*, v. 82, May 22, 1947, p. 75-78; discussion, p. 78-79.

Factors which promote a high degree of uniformity in melting rate, metal temperature, and quality—design; raw materials; and operation.

14-168. Production of Magnesium Alloy Castings. G. B. Partridge. *Metallurgia*, v. 36, May 1947, p. 7-12.

Gravity and pressure die-casting technique.

14-169. Drawing and Forming Steel With Zinc Alloy Dies. Part III. S. Menton. *Steel*, v. 120, June 9, 1947, p. 80-81, 109, 112, 114, 117.

Foundry practice for casting Kirksite; production of open molds, sands and binders for molds and cores, pouring techniques, and protective measures against warpage.

For additional annotations indexed in other sections, see:

2-96; **3**-150; **4**-64; **12**-97; **16**-74; **27**-110.

15 SALVAGE AND SECONDARY METALS

15-17. Waste Pickle Liquor. Richard D. Hoak. *Industrial and Engineering Chemistry*, v. 39, May 1947, p. 614-618.

The most important processes proposed for pickle-liquor treatment. Processes developed on a laboratory scale by the fellowship sustained at Mellon Institute by the American Iron and Steel Institute. No reasonably sound process is available for the treating of waste pickle liquor but research work now in progress indicates that this goal is in sight, but that a great deal of development work remains to be done.

15-18. Brass and Copper Industry. William S. Wise, Barnett F. Dodge, and Harding Bliss. *Industrial and Engineering Chemistry*, v. 39, May 1947, p. 632-636.

Brass and copper industry operations produce various wastes. Data on waste liquors from brass pickling. The treatment processes developed at Yale University and tested in a pilot plant. A few cost estimates. Two other proposed processes illustrated by flow diagrams.

15-19. Salvaging Iron Castings With Machinable Arc Welds. David W. DeArmand and Samuel Epstein. *Materials & Methods*, v. 25, May 1947, p. 68-72; *Western Machinery and Steel World*, v. 38, May 1947, p. 90-93.

How 45-lb. gray-iron pump casting, rejected because an area of the flange failed to fill during pouring, was salvaged.

15-20. Repair of Gray Iron Castings. C. E. Philips. *Welding*, v. 15, May 1947, p. 227-229.

Procedures.

16 FURNACES AND FUELS

16-62. Blowing-Out a Blast Furnace. R. Fowler. *Journal of the Iron and Steel Institute*, v. 155, April 1947, p. 513-518.

General considerations and blowing-on procedures. The method adopted at the Ebbw Vale plant of Messrs. Richard Thomas and Baldwins, Ltd. The blowing-out of No. 3 blast furnace at the works of The Park Gate Iron and Steel Co., Ltd., Rotherham, is described by J. W. Houghton in an appendix.

16-63. The Operation of Openhearth Furnaces With Coke-Oven Gas. D. Kilby. *Blast Furnace and Steel Plant*, v. 35, May 1947, p. 563-570.

British author feels that the straight coke-oven-gas-plus-illuminant method of firing is deserving of greater consideration under today's conditions. A detailed description of furnace design for use of coke-oven gas and pitch-creosote mixtures, including a number of detail diagrams, one of which is of a combined pitch-creosote and gas burner, and pitch-creosote atomizer. (To be continued.)

16-64. Oxygen Enriched Blast. Kurt Neustaetter. *Steel*, v. 120, May 19, 1947, p. 110, 112, 133.

Known facts concerning prospects of increasing oxygen content of air blown into the blast furnace. Theory, German experimental runs, and meager and vague information that has come out of Russia.

16-65. Comparison of Furnaces With One Checker and Two Checkers. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 41-44.

L. A. Lambing of Jones & Laughlin prefers single checkers. H. L. Allen of Republic prefers two-checker construction. Supporting data are given.

16-66. Labor-Saving Devices in the Openhearth. B. D. McCarthy. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 68-71.

Improved methods for slag removal, removal of flue dust, cleaning pits, materials handling, and other short cuts.

16-67. Labor-Saving Devices Used at Bethlehem Steel Company. T. A. Lewis. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 72-78.

Loading machine for removal of debris, vacuum system for cleaning flues, materials-handling systems, a checker-cleaning machine, and other arrangements used during rebuilding of openhearths.

16-68. Cleaning Checkers and Flues. Leland B. Luellen. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 84-85; discussion, p. 86-87.

Techniques at Inland Steel. James Smith of Republic Steel describes use of Zimmerman vacuum unit.

16-69. Results Obtained by Improved Furnace Design. Edward E. Callinan. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 295-297; discussion, p. 297-298.

Several design changes made in a stationary 65-ton acid-openhearth fuel-oil-fired furnace. The new design permitted the burning of fuel at a higher rate, thus allowing a decrease in melting time; and also resulted in decreased wear of refractories, hence longer furnace life, and in reduced maintenance and rebuilding costs.

16-70. Superheated Air Vs. Superheated Steam for "Atomization" of Fuel Oil. A. R. Altman. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 313-315; discussion, p. 315-316.

Comparative data for steel-melting experience at the Heppenstall Co., Pittsburgh. Inconclusive evidence favors superheated air.

16-71. Combustion Systems and Burners. Part II. Henry Schramm. *Steel Processing*, v. 33, May 1947, p. 304-307.

Design details of low-pressure systems and Premix burners used in the gas firing of industrial furnaces.

16-72. Crucible Melting Furnaces. *Light Metals*, v. 10, May 1947, p. 229-232.

Melting and holding furnaces installed in a British aluminum foundry for the production of gravity die-cast window frames.

16-73. Gas Heating Speeds Seamless Tube Production. E. S. Kopecki. *Iron Age*, v. 159, June 5, 1947, p. 64-68.

Installation at Babcock & Wilcox Tube Co., Beaver Falls, Pa., for which reduced operating costs, increased output, improved quality, and other advantages are claimed.

16-74. Foundry Coke and Its Relation to Cupola Melting. G. C. Creusere. *Canadian Metals & Metallurgical Industries*, v. 10, May 1947, p. 23-25, 41-42.

Problem of varying amounts of metal and scrap and its effect on coke efficiency. Production of coke and various qualities. Tests for coke and its thermal properties.

16-75. Furnaceless Heating and Small Gas Furnaces. J. F. Waight and J. Palser. *Gas Journal*, v. 250, May 14, 1947, p. 344-346; May 21, 1947, p. 405, 407, 409.

Use of concentrated-combustion burner systems for a variety of metallurgical processes. In many cases, use of these burners will permit elimination of furnaces. The construction and principles of these burners. (Paper presented to Sheffield Section of the Institution of Production Engineers, Feb. 19, 1947.)

16-76. The Application of Industrial Heating in the Fabrication of Aluminum Alloys at Reynolds Metals Plants. Part I. Furnaces for Processing Molten Metal. O. L. Mitchell. *Industrial Heating*, v. 14, May 1947, p. 726-728, 730, 732, 734, 736, 738, 740.

Illustrated and descriptive. (To be cont.)

16-77. The Calculation of Nickel-Chromium Resistors in Heat Treating Furnaces. Part II. Victor Paschkis. *Industrial Heating*, v. 14, May 1947, p. 756, 758, 760, 768.

A discussion of the mathematics concerned.

16-78. Symposium on Soaking-Pit Operation. Part II. *Industrial Heating*, v. 14, May 1947, p. 770, 772, 774, 776.

Summarizes a recent meeting of the Steel Works Section of the Engineers' Society of Western Pennsylvania, Pittsburgh.

16-79. Drying Ovens With Low Temperature Radiant Panels. Robert B. Grossman. *Industrial Heating*, v. 14, May 1947, p. 805-806, 808, 810, 812-814.

A successful application of radiant-panel drying.

16-80. Ferrous and Nonferrous Metals Treated in Commercial Steel Treating Co. Plant. Part II. *Industrial Heating*, v. 14, May 1947, p. 836, 838, 840, 842.

Heat treating facilities of the Commercial Steel Treating Co., Cleveland.

16-81. Heat Treatment Furnaces. *Metallurgia*, v. 36, May 1947, p. 31-38.

Some recent installations.

16-82. Gas Turbine Applications in Iron and Steel Works. *Journal of the Iron and Steel Institute*, v. 156, May 1947, p. 98-103.

A symposium consisting of the following sections: Power applications, by A. T. Bowden. Blast-furnace blowing applications — Section I, The axial blower, by W. H. Gibson; Section II, The bled-axial gas-turbine blower, by J. W. Railly; and Section III, Operation and control of the bled-axial gas-turbine blower, by R. G. Voysey.

For additional annotations indexed in other sections, see:

2-96-121-124-127; **5**-41; **11**-67; **13**-23-27; **14**-154; **18**-114; **27**-111.

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Function of Process Control Group Described

Left to Right Are D. M. McCutcheon, Ford Motor Co., Technical Chairman; C. L. Stevens, Ford Motor Co., Speaker; W. G. Patton, Iron Age, *Chairman of the Detroit Chapter; O. E. Cullen, Surface Combustion Co., Chairman of the Toledo Group; and W. P. Woodside, Past National President and Founder Member* ⊕

Reported by Don M. McCutcheon
Ford Motor Co.

Metallurgical process control is to production what preventive maintenance is to equipment but its effectiveness depends upon cooperation between the control group and those in production. This was the theme of Claud L. Stevens, head of the process control department of the Ford Motor Co., when he spoke before the Detroit Chapter ⊕ on May 12. Discussing the function and organization of a process control group, he gave examples to illustrate how it operates in the Ford Motor Co. The Toledo Group of the Detroit Chapter was specially honored at this meeting.

Process control is not concerned with the evaluation of alternate methods, which is the job of engineering and research, but it should operate to insure the highest percentage of useful parts once the best known method has been chosen. Briefly, the three major duties of a process control group are: To see that proper process specifications are made available to manufacturing units, to keep these specifications up to date; and to see that the processes are carried out in accordance with the specifications covering them.

More important than the size of the group is the selection of personnel fit for the job, since the effectiveness of the group depends on the degree of cooperation between it and the production divisions. Aside from the supervisors responsible for the policy and operation of the department, the group at Ford consists of specification writers, field men, specialists, and report analysts.

Specification writers collaborate with production men in writing step-by-step instructions for each process. These instructions are subsequently approved as specifications by the process control group and production group concerned. Such specifications can be changed only by agreement of both production and process control.

Field men work in a given area to see that process control specifications are followed and take up any deviations with supervisors of production and process control. Specialists in various processes assist the field men with problems that concern their specialty. Report analysts prepare report data for graphical analysis.

Process control is not concerned with acceptance of raw materials, but once they are put into the production line it is the duty of process control to see that they are processed in conformance with the specification for each operation. Where it is necessary to scrap materials, production and process control meet as a salvage committee to see how the material should be disposed of or reworked, and determine the most economical way of using it.

Ideally, every variable in production should be analyzed and specifications written to insure that it is under control. Process control at Ford extends from the steel mill on through all manufacturing operations until the finished product passes final inspection.

Pranik Takes New Position

Richard C. Pranik, past chairman of the Rhode Island Chapter ⊕, has been appointed vice-president in charge of engineering and manufacturing of the Seaboard Screw Corp., Providence, R. I. Mr. Pranik is a graduate of the University of Kentucky and has been metallurgical engineer of the American Screw Co. for the past 10 years.

17 REFRACTORIES Furnace Materials

17-42. Behavior of Various Types of Openhearth Bottoms in Service. R. B. Snow. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 87-92.

Observation and core drillings of a number of furnace bottoms. The density obtainable with the sintered-in type.

17-43. Comparison of Fully Rammed Bottoms, Partly Rammed Bottoms With Burned-In Top Surface, and Fully Burned-In Bottoms. B. D. McCarthy. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 93-95; discussion, p. 95-98.

Operating experience.

17-44. Experience With Sintered and Rammed Bottoms at Wisconsin Steel Works. E. H. Schwartz. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 98-102; discussion, p. 102-103.

Use of rammed hearths in basic openhearth furnaces compared with sintered-bottom results. J. L. P. McMahon describes experience at Pittsburgh Steel.

17-45. Inverted Arch Basic Brick Bottoms. H. M. Kraner. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 104-111; discussion, p. 112-114.

The evolution of design since 1936.

17-46. Fettling and Bottom Maintenance. J. E. Smith. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 114-115; discussion, p. 115-116.

Performance of several different refractories.

17-47. Progress Report—Basic Furnace Construction. A. K. Moore. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 262-264.

Experience at Steel Company of Canada on basic-end and basic-main-roof construction.

17-48. Progress Report on Basic-End Furnaces. Charles R. FonDersmith. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 264-268; discussion, p. 268-271.

Installation, cost data, and performance at American Rolling Mill Co. Appearance before and after campaigns. Report on basic refractories in German openhearth furnaces, by G. E. Seil.

17-49. Design and Construction of Plastic-Lined Doors. J. N. Hornak. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 271-279; discussion, p. 279-283.

Investigation was limited to the mechanical setup for holding the plastic material, the same plastic material being used throughout. Various designs tested and the condition of the linings after service. Several reports of the life of basic-rammed doors.

17-50. Progress in Silica Refractories. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 283-285.

Use of silica brick for openhearth roofs. High-silica mortars.

17-51. Progress in Mixer Linings. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 285.

Costs for sillimanite vs. first quality firebrick for steel ladle linings.

17-52. Relation of Insulation to Over-All Operating Economy. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.*, v. 29, 1946, p. 286-292.

Insulation of openhearth furnaces in relation to fuel economy, refractory consumption, air leakage, and over-all operating economy.

17-53. Special Refractories—Metal Melting. William H. Henson. *American Foundryman*, v. 11, May 1947, p. 64-70.

The various types and their properties.

17-54. Reactions of Different Clay Minerals With Some Organic Cations. R. E. Grim, W. H. Allaway, and F. L. Cuthbert. *Journal of the American Ceramic Society*, v. 30, May 1, 1947, p. 137-142.

Results of a fundamental study of the use of amines and other large organic cations in the production of lightweight insulating refractories. Selected samples of kaolinite, illite, and montmorillonite were washed free of replaceable bases, saturated with potassium ion, and then treated with various amine salts. This treatment reduced water-adsorbing capacity of the clays.

17-55. Reaction of Clays With Organic Cations in Producing Refractory Insulation. R. E. Grim, W. H. Allaway, and F. L. Cuthbert. *Journal of the American Ceramic Society*, v. 30, May 1, 1947, p. 142-145.

Since above reactions produce slips which shrink only slightly after casting and do not lose shape and porosity on drying or firing, the possibility of thus producing refractory insulation without final drawing to shape was investigated. Investigation of molding and other problems.

17-56. Method for Determining Tensile Properties of Refractory Materials at Elevated Temperatures. Joseph R. Bressman. *Journal of the American Ceramic Society*, v. 30, May 1, 1947, p. 145-152.

Development of equipment and technique for testing ceramic materials up to 2000° F. With this equipment, the tensile strength, stress-to-rupture characteristics, and modulus of elasticity of a sillimanite refractory were investigated.

17-57. Substitution of Domestic Minerals for India Kyanite: Part VI. Refractory Properties of Georgia Massive Kyanite. T. N. McVay and Hewitt Wilson. *Journal of the American Ceramic Society*, v. 30, May 1, 1947, p. 159-164.

Occurrence and mining problems of the Georgia material. Details of the preparation of refractories from it, and results of tests of the properties of the products.

17-58. Heat Treatment of Refractory Materials. (Continued.) *Refractories Journal*, v. 23, April 1947, p. 140-146.

Several German refractory plants and the techniques used in them. (Reprinted from Field Team Report B.I.O.S. 2065.)

17-59. Structural Design of Refractory and Heat Resistant Concrete. Part II. Methods of Reinforcing. *Industrial Heating*, v. 14, May 1947, p. 820, 822, 824, 826.

Basic design factors governing the use of refractory concrete made with calcium-aluminate cement. (To be continued.)

17-60. Minerals for Chemical and Allied Industries. Part X. Sydney J. Johnstone. *Industrial Chemist*, v. 23, May 1947, p. 303-311.

Metallurgical and chemical uses of limestone and lime. (To be continued.)

For additional annotations indexed in other sections, see:
2-113-115.

18 HEAT TREATMENT

18-100. Stabilizing Aluminum Castings. Avery C. Jones. *Metal Progress*, v. 51, May 1947, p. 775-776.

How cold treating solved a difficult production problem in the manufacture of hydraulic valves for aircraft.

18-101. Tempering of Toolsteels. Part I. Morris Cohen. *Metal Progress*, v. 51, May 1947, p. 781-788.

Results of an extensive investigation of the tempering process which is shown to be the result of at least four factors. Transformation curves for 18-4-1 high speed steel; and the four stages of tempering as determined by the microscope, by X-ray diffraction and by use of a combined magnetometer and dilatometer. Effect of time at temperature on hardness changes.

18-102. The Relationship of the Growth Exhibited on Nitriding to the Microstructure of the Nitrided Specimen. Part II. Lester F. Spencer. *Steel Processing*, v. 33, May 1947, p. 297-303.

Effects of different heat treating and quenching procedures. (To be continued.)

18-103. Strip Annealing. E. J. Seabold. *Iron and Steel*, v. 20, May 1947, p. 197-200.

Low-cost continuous electric heat-treatment. (Condensed from paper presented at meeting of American Association of Iron and Steel Engineers.)

18-104. Austempered Cast Iron Serves as Cylinder Liners. C. W. Ohly. *Materials & Methods*, v. 25, May 1947, p. 89-91.

Minimum distortion, no decarburization and uniform hardness are claimed in using salt baths for heat treating thin-walled, cylindrical, iron-alloy parts.

18-105. Heat Treatment of Dies. E. F. Watson. *Machinery (London)*, v. 70, May 8, 1947, p. 491.

Techniques for dies for hot stampings and pressings, shearing and punching dies for steel sheets and pressings, dies for molded products, plastics and clays and extrusion dies and mandrels.

18-106. Bethlehem Expands Toolsteel Facilities. R. J. Knerr and H. C. Bigge. *Iron Age*, v. 159, June 5, 1947, p. 69-73.

New and improved facilities for heat treatment, rolling, and forging.

18-107. Heat Treatment of Some Chromium-Nickel Alloys. H. A. Campbell. *Iron Age*, v. 159, June 5, 1947, p. 74-79.

Effects of heat treatment on the physical properties of some chromium-nickel alloys, including 18-8 stainless. The behavior of some of the alloys in sheet and tube form, during conversion to parts or structures and under service conditions. Heat treating precautions. 20 ref.

18-108. Developments in the Applications of Controlled Atmospheres. I. Jenkins. *Metallurgia*, v. 36, May 1947, p. 23-27.

Heat treatment developments.

18-109. Lead Hardening. Bernard Thomas. *Metallurgia*, v. 36, May 1947, p. 28-30.

Technique of lead hardening and the life of lead pots. Quenching mediums and the use of the salt bath for tempering.

18-110. New Fields for Prepared Atmospheres. W. A. Darrah. *Industrial Gas*, v. 25, May 1947, p. 12-14, 31-32, 34.

Miscellaneous applications.

18-111. Experiments on Quenching Media. F. W. Jones and W. I. Pumphrey. *Journal of the Iron and Steel Institute*, v. 156, May 1947, p. 37-54.

In a search for a standard test for comparison of hardening properties of different quenching media, cooling rates were determined at the center

(Turn to page 34)

Atomic Armament Race Is Already Under Way, Kirkpatrick Warns

Reported by V. E. Hense

Buick Motor Division

The world is in deadly peril because of the atomic armament race already under way among the nations, Sidney D. Kirkpatrick, editor of *Chemical Engineering*, warned members of the Saginaw Valley Chapter at the April meeting in Frankenmuth, Mich. Kirkpatrick, who witnessed the Bikini tests, expressed the belief that within the next five to ten years, any industrial nation would be able to build enough A-bombs to destroy the industrial capacity of any other country.

On the brighter side, he predicted that laboratory applications of atomic energy would be achieved in two or three years, followed by commercial use within ten years. The effect of the rays emitted by atomic fission upon metals, he said, is retarding peacetime application and at the same time complicates the problem of formulating adequate defense against an atomic bomb.

In the atomic armament race, cost is no factor, he declared. "What if an atomic bomb does cost $1,000,000?" he asked. "If you want to kill 100,000 people—as we did in Japan—the price is cheap."

Left, A. H. Karpicke, Chairman of the Saginaw Valley Chapter, and Right, Sidney Kirkpatrick, Editor of Chemical Engineering, and Speaker at the April Meeting

Kirkpatrick recommended world-wide control backed by force to block destructive use of atomic energy. "We must know how to use it, if necessary, in our national defense, and we must not neglect the study of every possible means of defending ourselves against its use by anyone else", he said.

He also gave some interesting sidelights on "Operation Crossroads" at Bikini. To board one of the ships in the target area immediately after the explosion and to remain for 24 hr. would be equivalent to being exposed to 1,000 chest X-rays. Following the under-water detonation, the half-mile thick pillar of water that rose a mile high remained virtually stationary for 70 sec., and when it dropped back, it made splashes 600 ft. high, according to Kirkpatrick's observations.

Following his talk, official Navy films of the A-bomb tests were shown.

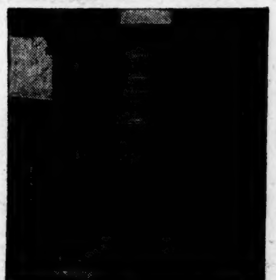
A-Bomb Movies Shown

Reported by Wylie J. Childs

Rensselaer Polytechnic Institute

"Operation Crossroads" was the subject of the monthly meeting of the Eastern New York Chapter held on May 12. A motion picture depicting last summer's atom bomb test at Bikini was shown by H. W. Bousman who is associated with the general engineering and consulting laboratory, General Electric Co. Mr. Bousman, who was the official representative of the American Institute of Electrical Engineering at the Bikini tests, gave a running commentary and description during the presentation of the film.

National Metal Congress and Exposition
Chicago, Oct. 18-24, 1947



of a silver cylinder. An attempt was made to correlate the cooling rates thus obtained with the hardnesses found in quenched 1½-in. cylinders of a high-carbon chromium-molybdenum steel. No simple method of correlation was apparent. Further quenching experiments were carried out with stainless steel cylinders of various diameters, and qualitative agreement was obtained between predictions based on cooling rates and experimental hardnesses in quenched cylinders of hardenable steels. 19 ref.

18-112. Annealing Salt for 18-8. Keith Whitcomb. *Steel*, v. 120, June 16, 1947, p. 86, 105-106, 109.

Results of experiments at Ryan Aeronautical which led to development of new and improved salt-bath annealing process for titanium or columbium-stabilized stainless used to conduct the exhaust gases from airplane engines. Results with five salt mixtures, of which only pure sodium carbonate was found to be entirely satisfactory.

18-113. Nitralloy Steels and the Nitriding Process. (Continued.) R. W. Allott. *British Steelmaker*, v. 13, May 1947, p. 240-245.

Resistance of nitrided surfaces to corrosion and their reduction of the failure-promoting tendencies of notches and surface scratches. The properties of Nitralloy and other nitriding steels, and certain pseudo-nitriding processes, such as cyanide-nitride casehardening. Nitriding developments during World War II; present research and future prospects.

18-114. Equalized Pressure Mixing in Automatic Atmosphere Generator. *Product Engineering*, v. 18, June 1947, p. 94-96.

Generator of atmosphere for bright hardening and brazing high-carbon steels. Methane, ethane, or butane gas are catalytically cracked to produce CO and H_2. The mixer-compressor unit.

For additional annotations indexed in other sections, see:

3-157; **4**-61; **9**-65; **14**-161; **16**-80-81; **20**-282-313; **23**-173-202; **24**-164; **25**-72; **27**-113.

19 WORKING — Rolling, Drawing, Forging

19-152. The Application to Shaping Processes of Hencky's Laws of Equilibrium. E. Siebel. *Journal of the Iron and Steel Institute*, v. 155, April 1947, p. 526-534.

Increase in pressure along slip lines, and the relationship between the mean pressure and the principal stresses as well as between the slip lines and the stress trajectories. Rules regarding the formation of slip lines. The gradual advance of slip layers in direct compression processes. Slip lines and stress conditions in cupping and related processes with consideration to die friction and the cohesion of the metal. Slip lines and stress conditions in pressing processes; various systems of slip layers. Effect of workhardening explained mathematically.

19-153. Tube Bending. C. F. Moore. *Refrigerating Engineer*, v. 53, May 1947, p. 409-411.

Shop tools and techniques for the bending of metal tubes of different sizes and materials to different radii.

19-154. Mechanical Cold Drawbenches for Ferrous and Nonferrous Tubes. Part III. G. W. Garwig and A. L. Thurman. *Blast Furnace and Steel Plant*, v. 35, May 1947, p. 549-552.

Auxiliary drives and control equipment. (Concluded.)

19-155. Drawing and Forming With Zinc Alloy Dies. S. Menton. *Steel*, v. 120, May 26, 1947, p. 92-93, 100, 102, 104, 107.

Use of Kirksite-type zinc alloys in production of automotive body parts. Physical characteristics and costs are compared with those of other materials. (To be continued.)

19-156. Progress in Steel Pipe Manufacture With Particular Reference to Seamless Pipe. E. N. Sanders. *American Iron and Steel Institute Preprint*, 1947, 9 p.

Development and important features of improved mill for sizes below 4½ in. O.D., being built by National Tube Co. at Lorain, Ohio.

19-157. The Joliet Coarse Rod Mill. R. R. Snow. *American Iron and Steel Institute Preprint*, 1947, 8 p.

Mill designed for high production of quality rods from billets 2½ in. x 2½ in. x 30 ft. over a range of rod sizes from 11/32 to 55/64 in., inclusive.

19-158. Design of a Mill for Rolling Semifinished Products. J. J. Curtin. *American Iron and Steel Institute Preprint*, 1947, 12 p.

Operator's problems in selecting the type and kind of mill that will answer his needs.

19-159. Heavy 75ST Spar Caps Bent. P. F. Girard. *Western Machinery and Steel World*, v. 38, May 1947, p. 101, 119.

How Ryan Aeronautical Co. has completed the severe bending of some of the heaviest spar caps made of 75ST aluminum alloy. Work was accomplished in the engineering laboratory on an experimental basis for a jet-plus-propeller Navy fighter.

19-160. Motor Selection for a Rolling Mill. L. H. Berkley. *Electrical Engineering*, v. 66, May 1947, p. 444-447.

Methods of analysis and calculations for a small brass-slab rolling mill can be applied to other installations.

19-161. Control of Raw Materials and Processes Assures Quality Aluminum Forgings. Lawrence J. Barker. *Materials & Methods*, v. 25, May 1947, p. 63-67.

Using Alcoa 14S alloy as a basis, unsatisfactory forged-aluminum parts can be avoided if stock is checked for hardness and surface defects and if proper dies and heat treatment are employed.

19-162. Processes Have Families. Edwin Laird Cady. *Scientific American*, v. 176, June 1947, p. 249-251.

Developments in clad steels, cutting tools, and materials.

19-163. Plate Mills. C. F. Buente. *United Effort*, v. 27, May 1947, p. 7-10.

Selection of equipment for rolling plates.

19-164. Forging Die Design. John Mueller. *Steel Processing*, v. 33, May 1947, p. 294-296.

The use of "grouping" to reduce the number of hammer blows and the amount of metal flash for a given number of forgings.

19-165. Wartime Forging; the Manufacture of Bomb Suspension Lugs. E. S. Gregory, W. J. Davies and E. R. Wellburn. *Iron and Steel*, v. 20, May 1947, p. 189-190, 192.

Procedures and special techniques utilizing machines designed for shell manufacture instead of drop forging, because of shortage of facilities for the latter.

19-166. Flexibility in Heavy Stampings. P. D. Aird. *Modern Industrial Press*, v. 9, May 1947, p. 13-14, 18, 38.

Daily production experience and routine of the Metal Fabricating Co., Detroit.

19-167. Stamping and Drawing of Cutlery and Silverware. Floyd McKnight. *Modern Industrial Press*, v. 9, May 1947, p. 22, 24, 26, 28.

How various tableware items are formed and plated. Types of machines and operations at several plants.

19-168. Press Work Important in Custom Fabrication of Switchboards. Walter Rudolph. *Modern Industrial Press*, v. 9, May 1947, p. 32, 34, 36.

Modern press equipment, special dies and procedures at Pelham Electric Manufacturing Corp., Erie, Pa.

19-169. Presses Produce Jet Fighter Parts. Howard E. Jackson. *Modern Industrial Press*, v. 9, May 1947, p. 40, 42, 44.

Equipment and procedures at Ryan Aeronautical Co.

19-170. Transfer Presses Boost Output at AC Spark Plug. Hubert L. Curtis. *American Machinist*, v. 91, May 22, 1947, p. 100-101.

How transfer presses aid production of metal stampings.

19-171. Die Design for Aluminum Alloys. E. W. Mason. *American Machinist*, v. 91, May 22, 1947, p. 102-104.

Press capacity, drawing-die materials, recommended lubricants and compression operations.

19-172. Drawing and Forming Steel With Zinc Alloy Dies. Part II. S. Menton. *Steel*, v. 120, June 2, 1947, p. 104-105, 128, 132, 134, 136, 138-140.

Factors in die designing, importance of alloy plasticity, use of inserts, binder rings.

19-173. New Tandem Cold Mill Rolls Strip at Mile a Minute. J. C. Sullivan. *Steel*, v. 120, June 2, 1947, p. 118, 121-122, 124.

First of new fast mills placed in production at Weirton designed with individually driven work rolls. Acceleration from 500 ft. per min. threading speed to 4000 ft. per min. rolling speed attained in 9 sec. Mill handles 15-ton coils.

19-174. Plastic Drop Hammer Dies. Gilbert C. Close. *Light Metal Age*, v. 5, May 1947, p. 9-10.

For forming of aluminum at the El Segundo plant of Douglas Aircraft.

19-175. The Rolling of Metals: Theory and Equipment. Part XIV. Methods Used in Practice for the Calculation of Rolling Load and Horsepower. (Continued.) L. R. Underwood. *Sheet Metal Industries*, v. 24, May 1947, p. 953-962.

Methods illustrated by two examples: Two-high single-stand sheet mill with plain bronze grease-lubricated roll-neck bearings and reversing four-high single-stand high-speed strip mill with motor-driven collers and fluid-film or roller bearings. (To be continued.)

19-176. Practical Problems of Light Presswork Production Presses. (Continued.) J. A. Grainger. *Sheet Metal Industries*, v. 24, May 1947, p. 965-966, 970.

The action of the fast-traversing hydraulic press. (To be continued.)

19-177. Some Comments on the Merits of Hydraulic and Mechanical Presses for Sheet Metal Drawing. *Sheet Metal Industries*, v. 24, May 1947, p. 967-970.

Several comments on J. A. Grainger's article in the April issue.

19-178. Discussion of Technical Papers at the Winter Conference of the Sheet and Strip Metal Users' Technical Association. *Sheet Metal Industries*, v. 24, May 1947, p. 1009-1013.

Discusses the development of zinc alloy tools for blanking, piercing and forming sheet metal parts, by J. W. Sladden and H. S. Walker. Methods of studying the behavior of steel during welding, by H. Granjon.

19-179. The Joliet Coarse Rod Mill. R. R. Snow. *Blast Furnace and Steel Plant*, v. 35, June 1947, p. 687-690.

Joliet mill built 14 ft. above grade allowing room beneath for offices and equipment. Proper arrangement of supplies for continuous feeding. Fur-

(Turn to page 36)

Compliments

To Ernest E. Thum ⊕, editor of *Metal Progress*; John Chipman ⊕, professor of metallurgy at Massachusetts Institute of Technology; H. J. French ⊕, vice-president of International Nickel Co.; Cyril S. Smith ⊕, director of the Institute for the Study of Metals, University of Chicago; and O. T. Marzke ⊕, superintendent of the metallurgy division, Naval Research Laboratory; on their appointment to a newly formed five-man Metallurgical Advisory Committee to the National Bureau of Standards.

To Robert Lindley Ziegfeld ⊕, formerly assistant secretary, on his election as acting secretary and treasurer of the Lead Industries Association, New York.

To H. B. Meyers ⊕ on his appointment as a fellow on the Abrasives Fellowship sustained by the Carborundum Co. at Mellon Institute of Industrial Research.

To Truman S. Fuller ⊕, supervisor of the Schenectady Works laboratory of the General Electric Co., and H. L. Maxwell ⊕, supervisor of general consultants of E. I. du Pont de Nemours & Co., on their appointment to the board of directors of the American Society for Testing Materials.

To Walther Mathesius, past national trustee ⊕ and past chairman of the Chicago Chapter, president of the Geneva Steel Co., Salt Lake City, Utah, on his election as a director of the parent company, U. S. Steel Corp. of Delaware.

To Edward S. Christiansen ⊕, president of the Magnesium Co. of America, Chicago, on the award of a plaque by the Magnesium Association recognizing his vision and energy in promoting the organization of the association in 1943.

To Leeds & Northrup Co., Philadelphia, on its pictorial display of precision measuring and control instruments presented in the industrial photographic gallery of the Franklin Institute during May.

Correction, Please

Four names were inadvertently omitted from the personnel of the Metals Handbook Tool Steel Committee published in the June issue of *Metals Review*, page 41. The members of the committee who were not listed are A. G. Spencer, Chevrolet Motor Division, General Motors Corp.; Reinhold Schempp, Halcomb Division, Crucible Steel Co. of America; W. H. Wills, Allegheny Ludlum Steel Corp.; and G. P. Witteman, Bethlehem Steel Co.

Describes Reflectoscope

Reported by Russell L. Wilcox
Bethlehem Steel Co.

A detailed description of the Supersonic Reflectoscope was presented before the April meeting of Baltimore Chapter ⊕ by E. A. Crawford, manager of engineering, Sperry Products.

This machine can detect by means of sound waves internal flaws in machine parts, castings, and forgings. The action of the sound waves is indicated on an oscilloscope which, when properly interpreted, shows the nature and location of the flaw. The machine is now in wide use in industry and permits rapid, effective, nondestructive testing with complete safety.

In a coffee talk given by J. G. Buchanan of Lloyd's Register of Shipping, the workings of the famous insurance firm were explained.

Film on Aluminum Offered

"This Is Aluminum", a new Bureau of Mines educational sound motion picture depicting production of aluminum from ore to finished materials, is available for free showings to schools and colleges, industrial and vocational training groups and other organizations. Applications for short-term loan should be addressed to the Graphic Services Section, Bureau of Mines Experiment Station, 4800 Forbes St., Pittsburgh 13, Pa., and should state specifically that the borrower has necessary equipment to show 16-mm. sound films.

naces. The construction of the mill. Reels on which rod is wound. Finishing and shipping. (Abstract of a paper read at meeting of American Iron and Steel Institute, New York, May 21 and 22, 1947.)

19-180. Progress in Steel Pipe Manufacture With Particular Reference to Seamless Pipe. E. N. Sanders. *Blast Furnace and Steel Plant,* v. 35, June 1947, p. 691-694.

Types of pipe produced. Need for operating economy. Production of seamless pipe and the seamless mill. (Abstract of paper read at meeting of American Iron and Steel Institute, New York, May 21 and 22, 1947.)

19-181. Design of a Mill for Rolling Semifinished Products. J. J. Curtin. *Blast Furnace and Steel Plant,* v. 35, June 1947, p. 702-706.

Size of product to be rolled, source of steel supply, quality of product and tonnage required affect choice of rolling mill. General construction features and advantages of continuous mills which follow and operate in line with blooming mill, cross-country mill and the three-high billet mill. (Abstract of a paper read at meeting of American Iron and Steel Institute, New York, May 21 and 22, 1947.)

19-182. Forging Developments at Oldsmobile Plant. *Automotive and Aviation Industries,* v. 96, June 1, 1947, p. 46.

Picture story of improved techniques.

19-183. Reversing and Tandem Cold Mills. M. D. Stone. *Iron and Steel Engineer,* v. 24, May 1947, p. 65-72; discussion, p. 72.

A comparison of the tandem mill with the reversing mill emphasizes the point that the reversing mill offers lower investment cost and greater flexibility, whereas the tandem mill gives lower operating cost and greater production.

19-184. Form Tools. (Continued.) W. F. Walker. *Edgar Allen News,* v. 25, May 1947, p. 827-828.

Circular form tools. (To be continued.)

19-185. The Cold Heading Process. F. Rhodes. *Machinery (London),* v. 70, May 1, 1947, p. 449-451.

Its advantages and extending field of application.

19-186. Hot Dimpling and Joggling 75S-T for the DC-6's. Floyd E. Bryan and Don E. Bailey. *Machinery,* v. 53, June 1947, p. 146-150, 189.

Practice of the Douglas Aircraft Co. in extensive application of new high-strength aluminum alloy.

19-187. Forming Aluminum Sheets Into High-Strength Structures. Bernhard Rogge. *Machinery,* v. 53, June 1947, p. 174-179.

How sheet-metal structures, formed into a waffle-bead pattern by drop-hammers or hydraulic presses, are being used for such airplane parts as engine cowlings, floor panels, outer wing sections, and door panels at Glenn L. Martin Co.

19-188. Drawing and Forming Steel With Zinc Alloy Dies. S. Menton. *Steel,* v. 120, June 16, 1947, p. 94-96, 122, 124, 127-128, 130.

Finishing operations on draw and forming dies, press tryouts, pressure-equalizing blocks, rebuilding or modifying dies, as well as other applications. (Concluded.)

19-189. Production Processes. Their Influence on Design. Part XXIV. Press Brake Forming. Roger W. Bolz. *Machine Design,* v. 19, June 1947, p. 137-142.

Types of items which should be made by press-brake forming and principles for their design.

For additional annotations indexed in other sections, see:

4-61; **16**-73; **18**-105-106; **20**-261-295; **21**-51; **22**-282; **23**-166-173-175; **24**-150-152-154-167-168-170; **25**-90; **27**-108.

20 MACHINING AND MACHINE TOOLS

20-256. Profile Machining. N. J. Cooke. *Engineering,* v. 183, April 18, 1947, p. 342.

Profile machining operations in the repetition production of large numbers of small to medium parts on capstan lathes and automatics. (Condensed from paper presented to the Institution of Production Engineers, North-Eastern Section, Jan. 20, 1947.)

20-257. Crosleys on the Production Line. Joseph Geschelin. *Automotive and Aviation Industries,* v. 96, May 15, 1947, p. 28-32, 74, 76.

Latest tooling and assembly methods. Operating sequence and equipment for crankcase and cylinder-block machining.

20-258. Unusual Machining Flexibility Permits Production of Engines of Different Sizes and Types. *Automotive and Aviation Industries,* v. 96, May 15, 1947, p. 39, 64.

How fixtures are adapted to handle blocks of different sizes and types at Buda Co.

20-259. Hardness Distribution in Chips and Machined Surfaces. Norman Zlatin and M. Eugene Merchant. *Iron Age,* v. 159, May 22, 1947, p. 69-75.

Experimental work showed that the hardness of steel may be increased as much as 300% during the machining process, which fact has important bearing on the life of cutting tools and the serviceability of the machined surfaces. A method is given whereby the hardening produced by cutting can be predicted from the workhardening properties of the metal. The usefulness of microhardness tests as an aid in the study of machinability.

20-260. How to Use Carbide Cutters for Milling. Part XIII. H. A. Frommelt. *Iron Age,* v. 159, May 22, 1947, p. 77-79.

How to select the correct feed rates for the 11 major groups of materials, and how to select the most suitable size of cutter.

20-261. Composition, Control and Selection of Coolants for Working Metals. E. L. H. Bastian. *Steel,* v. 120, May 26, 1947, p. 94-95, 107-108, 112.

Selection of coolants for various operations including rolling, drawing, and grinding.

20-262. Manufacture, Selection and Use of Files. L. E. Browne. *Steel,* v. 120, May 26, 1947, p. 96-98, 132, 134, 136.

Best procedures for filing die castings, saws, extra-soft materials, and for precision work. (Concluded.)

20-263. Knight-Case Investigation on Lapping. *Industrial Diamond Review,* v. 7, April 1947, p. 102-104.

Work done by Knight and Case, originally published in 1915.

20-264. Grinder for Small Twist Drills. H. Long. *Industrial Diamond Review,* v. 7, April 1947, p. 112-113.

Machine developed by an instrument manufacturer for his own use.

20-265. Diamond Splinters for Truing. *Industrial Diamond Review,* v. 7, April 1947, p. 116.

How diamond chips mounted in soft brass, copper, or light metal were used for grinding thread gages since 1937 in Germany. (Translated from *Werkstattstechnik & Werksleiter,* v. 36, 1942, p. 470.)

20-266. Chipless Cutting of Metal? *Industrial Diamond Review,* v. 7, April 1947, p. 116.

Accomplishments in Germany. The chips are said to entirely burn up during the cutting operation, in which tungsten carbide and extremely high surface speeds are used.

20-267. Optimum Surface Finish With Sintered Carbide Tools. R. Gottschald. *Industrial Diamond Review,* v. 7, April 1947, p. 122.

Surface finishes and methods of evaluating them. Results of experimental work in which surface finish obtained in machining of steel is correlated with the different operating factors involved. (Translated and abstracted from Doctorate Thesis, Technical High School, Dresden, 1942.)

20-268. Friction Cutting Stainless. H. J. Chamberland. *Western Metals,* v. 5, May 1947, p. 28-30.

Techniques with table of saw velocities and pitches for various types and thicknesses of steel.

20-269. Automotive Cylinder Bore Size Automatically Controlled. *Steel,* v. 120, May 19, 1947, p. 96, 99.

A honing machine is equipped with a 6-spindle head, tools and fixtures. In a honing cycle of 30 sec., equipment removes an average of 0.004 in. of stock from each of the six bores, corrects out-of-roundness and taper, and holds bore-to-bore size within a limit of 0.0005 in.

20-270. Air Scanning Simplifies Irregular Contour Work. *Steel,* v. 120, May 19, 1947, p. 114.

New contour device provides accurate sizing, automatically, in turning, boring and facing of irregular-contour work. Matches the master templet within a limit of tenths.

20-271. Engineering Shop Notes. *Materials & Methods,* v. 25, May 1947, p. 132-133.

Mechanical handling of gear blanks speeds production. A simple quick-acting drill jig. Three-dimensional layout and inspection of castings.

20-272. Recent Developments in Crush Grinding Thread and Annular Forms. C. J. Linxweiler. *Tool Engineer,* v. 18, May 1947, p. 27-32.

Advantages of crush grinding for production of complex contours. Details of the Sheffield thread and form grinder. Annular-form crush grinding for the manufacture of circular form tools; production of annular forms; limits of application; choice of coolants; improvement of wheel specifications; crusher roll materials; effect of gashes on crusher life.

20-273. Drilling and Boring Tools. No. 10. *Tool Engineer,* v. 18, May 1947, p. 45-46.

Precision boring and hole finishing. (To be continued.)

20-274. Gadgets. *Tool Engineer,* v. 18, May 1947, p. 65.

Cut-off for hoppers which feed screws or rivets to drilling machines or punch presses, and a plastic drill jig for short production runs.

20-275. Bores Ground to Half A Millionth. E. J. Tangerman. *American Machinist,* v. 91, May 22, 1947, p. 93-95.

How precision to 0.000005 in. and smoothness to 0.0000005 in. have been obtained in internal grinding without lapping and honing.

20-276. Reduced Wear on the Way. *American Machinist,* v. 91, May 22, 1947, p. 96.

Fabric-reinforced phenolic sheet provides low-friction planer ways for loading to 50 psi. and speeds to 400 ft. per min.

20-277. Single-Cycle Tapping Reduces Breakage. Ed Anderson. *American Machinist,* v. 91, May 22, 1947, p. 105-106.

Rack-and-gear method is basis for high-production tapping on punch presses on straight-line power such as an air cylinder.

20-278. Some Face-Milling Observations. A. O. Schmidt. *American Machinist,* v. 91, May 22, 1947, p. 106.

Research on high speed indicates effectiveness of cutters with inserted cemented-carbide blades at positive radial-rake angles provided at the cutting edge with a negative radial-rake angle 1½ times the width of feed per tooth.

20-279. How to Specify Machine Tools for Carbides. Part II. H. A. Frommelt. *American Machinist,* v. 91, May 22, 1947, p. 108-109.

(Turn to page 38)

Barnett Explains Lehigh System for Weldability Test

Reported by J. W. Haupt

Chief Design Engineer
Cardwell Mfg. Co., Inc.

"Welding the Hardenable Steels" was the subject of a joint meeting of the Wichita Chapters of the American Society for Metals and the American Welding Society. The speaker was Orville T. Barnett, division engineer, electrode division, Metal and Thermit Corp.

The "Lehigh System", which was developed at Lehigh University for predicting the weldability of steels, as explained by Mr. Barnett, is based on the angle of radial bend of a welded specimen as a criterion of acceptability of the joint. A specimen which will bend 20° has been selected as the lowest safe value for average structures that are not to be stress relieved after welding. If stress relieving is practiced, a bend ductility of 10° is permissible.

Angle of bend may be plotted against hardness for a given material so that the hardness value may be used instead of a bend specimen, if desired.

In order to weld a hardenable steel satisfactorily, the cooling rate must not be too rapid. Cooling rate may be slowed down by using a higher heat input. Offsetting this factor is the rate of heat dissipation, which is affected by *(a)* joint design, *(b)* thickness of parent metal, and *(c)* initial temperature of parent metal. Only the metal within 3 in. of the weld has any effect on the cooling rate.

By using S-curves Mr. Barnett explained the formation of desirable or undesirable structures in or near the welded joint. Martensite formation is not desirable and preheating and postheating may be used to remedy this.

Another undesirable condition—the presence of hydrogen in the weld and in the heat-affected zone — has been effectively remedied by the recently developed lime-ferritic electrodes. Welds produced with these electrodes on hardenable steel have higher yield and ultimate strength and at the same time percentages of elongation and reduction of area are higher. Furthermore, a marked improvement in impact strength is obtained.

Mr. Barnett then gave specific examples of the use of this electrode.

Chicago Offices Moved

Gas Machinery Co. of Cleveland and Harmon and Co., engineers and distributors, have moved their Chicago offices from 6 North Michigan Ave., to 208 Palmolive Building. The Gas Machinery Co. manufactures industrial furnaces, and Harmon and Co. is distributor for Eder-Lite miniature inspection lamps for illumination of hard-to-get-at places.

Georgia Chairman at Southern Metals Expo

Left to Right Are Mayor Wm. B. Hartsfield of Atlanta; R. S. Lynch, President, Atlantic Steel Co.; and Governor M. E. Thompson of the State of Georgia, in Front of the Atlantic Steel Co.'s Booth on the Opening Night of the Second Southern Machinery and Metals Exposition. The mayor officially opened the exposition and the governor made the keynote address. Mr. Lynch is chairman of the Georgia Chapter and was president of the Southern Machinery and Metals Exposition

How greater efficiency can be obtained through use of proper design considerations. (To be continued.)

20-280. Practical Ideas. *American Machinist,* v. 91, May 22, 1947, p. 131-136.

Precision taper measurement with micrometer calipers. Internal taper measurement. Pneumatic drill and mill run on lathe turret. Inserted-bit milling cutter. Offset straps. Piloted countersink. Collar keeps record of boring-tool settings. Wooden base positions milling attachments. Split-barrel wrench does difficult job. T-handle.

20-281. Electric Range Production. *Western Machinery and Steel World,* v. 38, May 1947, p. 86-89.

Equipment and procedures employed.

20-282. Special Jig Grinder. Raymond O. Catland. *Western Machinery and Steel World,* v. 38, May 1947, p. 98-99, 119.

Machine grinds straight holes, tapered holes in either direction, or contour grinds, blending of radii or the blending of straight with curved surfaces. Exceptionally useful in making dies, particularly of the injection-molding type. Distortion of tools, due to heat treatment, can be corrected with ease. It is unnecessary to locate holes with precision before heat treatment because dimensional accuracy can be had by grinding after hardening.

20-283. Job-Engineered Equipment. *Western Machinery and Steel World,* v. 38, May 1947, p. 104-107.

Machines designed and produced by West Coast manufacturer.

20-284. Machining Diesel Engine Components. *Machinery (London),* v. 70, May 8, 1947, p. 477-482.

Practice of the Turner Manufacturing Co., Ltd., for machining cylinder, crankshaft, and flywheel.

20-285. Developments in Honing Practice. *Machinery (London),* v. 70, May 8, 1947, p. 483-485.

Advances made in the technique of honing both during and since the war, and the machines and tooling equipment developed by the micromatic Hone Corp., Detroit.

20-286. Accuracy Requirements for Heavy Machine Tools. J. H. Rivers. *Machinery (London),* v. 70, May 8, 1947, p. 486-490.

Spindle-bearing design and cambering mechanism for roll grinding. (Abstract of paper read before the Institution of Production Engineers. To be continued.)

20-287. What the Machine Tool Show Means to Metalworking Executives. Guy Hubbard. *Steel,* v. 120, June 2, 1947, p. 98-100.

Brief report on signs and portents of the current wave of design activity in the realm of machine-shop practice.

20-288. A Fresh Approach to Machining Diesel Engine Parts. E. K. Morgan. *Steel,* v. 120, June 2, 1947, p. 106-108, 142-143.

Adaptability of horizontal machines for variety of operations.

20-289. How to Use Carbide Cutters for Milling. Part XIV. H. A. Frommelt. *Iron Age,* v. 159, June 5, 1947, p. 80-83.

Necessity for carefully analyzing the workpiece for its metal-removal possibilities. How the feed rate should be established for minimum operation time, and how chip loads should be checked before putting a job into production. Merits of climb milling.

20-290. Skoda Universal Lathes. Joseph Pic. *Engineers' Digest (American Edition),* v. 4, May 1947, p. 236-238.

Recent improvements in lathe construction. (Translated and condensed from *Strojnicky Obzor,* v. 26, Sept. 1946, p. 159-165.)

20-291. Internal Grinding. *Automobile Engineer,* v. 37, May 1947, p. 169-170.

Recent developments in Churchill (British-made) automatic-sizing machines.

20-292. Form Wheel Dressing. *Automobile Engineer,* v. 37, May 1947, p. 187-189.

Tests carried out by Jones and Lamson Machine Co. in the U. S. to determine the relative efficiencies of the two techniques. It is shown that although a crush-dressed wheel will produce more pieces before redressing is necessary, a diamond-dressed wheel will give a better finish and greater accuracy and a higher rate of stock removal.

20-293. Form Grinding. *Automobile Engineer,* v. 37, May 1947, p. 190.

An interesting automatic cycle on a centerless machine.

20-294. Report on Bristol Type 167. *Aircraft Production,* v. 9, May 1947, p. 167-174.

Spar assembly; machining the main longerons or supplementary booms; rib construction; and innerwing assembly.

20-295. Seafire Leading-Edge Skins. L. G. Burnard. *Aircraft Production,* v. 9, May 1947, p. 177-182.

The very comprehensive routing and drilling equipment for the finishing of the wing panels after the stretching operation.

20-296. Profiling Impeller Vanes. Part II. *Aircraft Production,* v. 9, May 1947, p. 183-188.

The intricate but effective hydraulic servomechanism by which the machine translates the contours of a master pattern into the movements of cutters which simultaneously shape two stampings. The equally ingenious Keller machine used by de Havilland for the same purpose.

20-297. Concentric and Eccentric Machining With One Chucking of the Part. Maurice C. Ohl. *Screw Machine Engineering,* v. 8, May 1947, p. 38-40.

Technique employed.

20-298. Milling Corrugations on the Multiple Spindle Bar Machine. *Screw Machine Engineering,* v. 8, May 1947, p. 41-43, 46.

Details of the operation.

20-299. Graphic Method of Computing Swing Stop Clearances. T. C. Cairns. *Screw Machine Engineering,* v. 8, May 1947, p. 48-51.

Often, on a Brown & Sharpe automatic, after several valuable hours of preparation and tool setup time have been spent, it is discovered that not enough cam space has been allowed for clearance between the swing-stock stop and the first turret tool. How this may be avoided.

20-300. Stock Ends. *Screw Machine Engineering,* v. 8, May 1947, p. 65.

Turret adaptor. Stock-feeding technique. Use of a spring-loaded brass plunger to prevent damage to thin-walled parts when ejecting from the turret.

20-301. Autocar Installs Special Machine for Boring Crankcases. *Automotive and Aviation Industries,* v. 96, June 1, 1947, p. 42.

Machine and its operation.

20-302. How to Specify Machine Tools for Carbides. Part III. H. A. Frommelt. *American Machinist,* v. 91, June 5, 1947, p. 120-123.

Power requirements, separate spindle drives, automatic feed changes, number and adjustment of spindles, flywheel effect and workhandling.

20-303. Practical Ideas. *American Machinist,* v. 91, June 5, 1947, p. 125-132.

Small index plate attachment doubles all hole combinations. Telescoping valve retracts when pressure is off. Eccentric-scriber tram. High-speed pin cutter. A tip on tube tapping. Split-bushing expanding mandrel has flexibility of application. Chisel withdraws pipe nipples. Dressing wheels for concave grinding with proper angles. Puller removes all bearings without damage. V-block and clamp unit speeds tapping jobs. Tailstock setup chases small screws. Poke your feed tubes out through the wall. Simple safety hook. Drillpress undercutting tool. Automatic ejector improves Rockwell hardness tester. Height gage sets planer and shaper tools. Automatic lathe dog has quick-acting lock.

20-304. Machining Jaguar Connecting Rods. *Machinery (London),* v. 70, May 1, 1947, p. 452-456.

Techniques used on light-alloy rods at British firm.

20-305. Diameter and Linear Tolerances on Tapers. W. Richards. *Machinery (London),* v. 70, May 15, 1947, p. 505-509.

Methods of gaging taper-fit assemblies.

20-306. Production of the Leytool Hand Drill. *Machinery (London),* v. 70, May 15, 1947, p. 510-514.

Machine-shop operations in production of British-made tool.

20-307. Klingelnberg Leadscrew Play Compensating Device. *Machinery (London),* v. 70, May 15, 1947, p. 514.

German device which enables one or both flanks of a worm thread to be ground during traverse of the work past the grinding wheel in both directions.

20-308. Measuring Lathe Spindle Speeds. *Machinery (London),* v. 70, May 15, 1947, p. 516.

Simple methods use only a stop watch, or a 60-to-1 worm reduction gear, respectively.

20-309. Lens Grinding Principles Applied to the Machine Shop. J. A. T. Crump. *Machinery (London),* v. 70, May 15, 1947, p. 517-518.

How to produce large spherical areas on moderate sized grinding wheels.

20-310. Turning. Part I. Guy Hubbard. *Steel,* v. 120, June 9, 1947, p. 74-75, 122.

Ways and means of cutting costs and increasing production through the use of modern machine tools.

20-311. Aircraft Engines of Tomorrow in Production Today. Part I. Charles H. Wick. *Machinery,* v. 53, June 1947, p. 138-145.

Some of the methods employed by the Allison Division of General Motors in producing engines. (To be continued.)

20-312. Cylinder Production for the "Wasp Major" Engine. T. J. Crowley and F. J. Carney. *Machinery,* v. 53, June 1947, p. 152-159.

Production methods of machining forged aluminum alloy cylinders at Pratt & Whitney Aircraft. Multiple-station transfer and special finning machines are featured.

20-313. Precision Machining and Heat Treating of Aircraft Engine Gears. Vallory H. Laughner. *Machinery,* v. 53, June 1947, p. 168-173.

Precautions taken by the Wright Aeronautical Corp. to eliminate inaccuracy and distortion during machining, heat treating, and casehardening of aircraft reduction gears.

20-314. Precision Building of Convair-240's for Low-Cost Maintenance. G. F. Gerhauser. *Machinery,* v. 53, June 1947, p. 180-184.

Tooling designed so that assemblies and parts are interchangeable. Planning of assembly and parts for each assembly.

20-315. Transfer Machine of Sectional Design. *Machinery,* v. 53, June 1947, p. 192-195.

How Baush Machine Tool Co. of Springfield, Mass., has sectionalized its transfer machine for machining automotive transmission cases, so that individual units are as independent as in the more conventional production lines.

20-316. Tool Engineering Ideas. *Machinery,* v. 53, June 1947, p. 203-205.

Self-centering reaming fixtures for spinning caps, by Robert Mawson. Simple device for radius or profile turning, by Donald Baker. Tool for aligning lathe tailstock with work in chuck, by H. Moore. Versatile work-holding device with adjustable clamping pressure, by Mark W. Purser.

(Turn to page 40)

Corrosion Research Evolves New Theory For Passivation

Reported by R. E. Christin

Chief Metallurgist
Columbus Bolt Works Co.

How and why corrosion occurs was accented in a talk on "Recent Developments in Corrosion Research" by Mars G. Fontana, professor of metallurgical research and director of the corrosion research laboratory at Ohio State University, before the Columbus Chapter ⊕ on May 13. Corrosion research programs have increased tremendously in recent years, and much of the present research on corrosion is fundamental in nature, Dr. Fontana pointed out in describing the extensive corrosion research program at Ohio State.

M. G. Fontana

In connection with the passivation of stainless steel, a new theory has been developed. The passive surface on 18-8S is believed to consist of a physically adsorbed gas. Passivity develops upon exposure to air and breaks down when exposed to vacuum at room temperature. The process is reversible in that passivity can be developed and broken down continuously by alternate exposure to air and low pressures. The deficiencies of the commercial "passivation" treatment with nitric acid were pointed out. (A more complete exposition of this theory is contained in the June issue of *Metal Progress.*)

Improved testing methods to obtain more reliable data for predicting service life of equipment were exemplified by apparatus and data for erosion-corrosion tests. The wide difference between such data and those obtained by ordinary static corrosion tests was shown. Examples of plant failures caused by improper corrosion testing were given.

Recent research has resulted in the development of high nickel-base alloys for severe services, and Dr. Fontana described the effects of heat treatment, including aging, on the resistance to over-all corrosion and pitting of these alloys.

In the study of high-temperature oxidation, it was found that low oxygen content in the gases forms more protective scales than high oxygen content, based on subsequent exposure to 20% oxygen, 80% nitrogen atmospheres at 1800° F. Oxidation tests on 16-25-6 alloy were also described.

Corrosion research in other universities and several industrial laboratories was mentioned, and the great demand by industry for metallurgical engineers trained in corrosion work was emphasized.

20-317. Drilling. Guy Hubbard. *Steel,* v. 120, June 16, 1947, p. 88-89, 134.

The development of mass production of holes, and the role played therein by modern machine tools.

20-318. A Tooling Program for Forged Globe Valves. Part VIII. Carl F. Benner. *Tool & Die Journal,* v. 13, June 1947, p. 78-83, 138.

Machine-shop operations in manufacture of Parker offset globe valves. (To be continued.)

20-319. A Duplicator Must Duplicate. *Tool & Die Journal,* v. 13, June 1947, p. 84-85, 88-90.

A number of hydraulic duplicating attachments for machine tools, manufactured by the Turchan Follower Machine Co. of Detroit.

20-320. Dual Belt-Gear Drive Increases Lathe Adaptability. *Product Engineering,* v. 18, June 1947, p. 96.

Two separate driving mechanisms—gear drive and direct belt drive—provide 12 spindle speeds in low and carbide ranges.

20-321. Tap Support Increases Flute Grinder Accuracy. *Product Engineering,* v. 18, June 1947, p. 98.

Design details of machine tool for accurate grinding of small spiral-pointed taps.

For additional annotations indexed in other sections, see:
19-162; **24**-149-153-156-157-165; **27**-114-116.

21 LUBRICATION and Friction; Bearings

21-50. Electron Diffraction Study of Oleophobic Films on Copper, Iron and Aluminum. L. O. Brockway and J. Karle. *Journal of Colloid Science,* v. 2, April 1947, p. 277-287.

Results of a fundamental study of the above films. New procedures which had to be developed. Stearic acid and n-octadecylamine were the film liquids investigated.

21-51. Roll-Neck Bearings. *Journal of the Iron and Steel Institute,* v. 155, April 1947, p. 593-608; discussion, p. 608-620.

Papers read at the afternoon session of the second meeting of the Iron and Steel Engineers Group of the Iron and Steel Institute: White-metal bearings applied to hot steel rolling mills, by J. M. Borland. Roller bearings, by L. R. Pearson. Synthetic-resin bearings, by F. W. Jones. Oil-film-type bearings, by G. R. Walshaw.

21-52. Preparing Bearing Shells for Babbitting. A. A. Goodman. *Metal Progress,* v. 51, May 1947, p. 776.

Serrated bore is now used to aid bonding of babbitted bearing liners to steel and bronze shells. This practice saves both time and babbitt metal in comparison with older method in which slots were cut in the shell bore.

21-53. Composition, Control and Selection of Coolants for Working Metals. E. L. Bastian. *Steel,* v. 120, May 19, 1947, p. 82-83, 117, 120, 124.

Important group of water mixtures or solutions used as coolants in metal-working. Compositions of typical water soluble or emulsifiable materials, the preparation of aqueous coolants for use, their care, maintenance, and control in use, and the relative suitability of water coolants versus other types of fluids.

21-54. Smooth Surfaces Increase Plain-Bearing Capacity. E. L. Hemingway. *American Machinist,* v. 91, June 5, 1947, p. 92-95.

Tests with recording wattmeter show smooth surfaces, will carry heavier loads, run cooler, can be fitted to closer tolerances, and suffer much less wear.

21-55. Lead-Base Babbitt Alloys. Part II. Fatigue and Wear Properties. Henry P. George. *Product Engineering,* v. 18, June 1947, p. 138-141.

Results of simulated service tests on ten lead-base babbitt bearing analyses are compared to those on a tin-base babbitt bearing. The load carrying ability of bearings of the ten materials are given. Results of fatigue tests on babbitt-steel strips.

For additional annotations indexed in other sections, see:
19-171-175; **23**-198.

22 WELDING Flame Cutting; Riveting

22-252. Factors Influencing the Selection of Coating Ingredients for A.W.S. Type E6020 Electrodes. Boyd E. Cass. *Foote Prints,* v. 18, no. 2, 1947, p. 13-19.

Experimental work conducted to determine the effect on electrode performance of variations in chemical composition and particle size of the coating materials.

22-253. What Is Proper Resistance Welding Control? Part II. G. W. Garman. *Industry and Welding,* v. 20, May 1947, p. 36-37, 39, 64-65.

Why control is needed and how proper control equipment fills this need. Requirements for each type of resistance welding.

22-254. Clear the Track for Welding. Part II. H. S. Swan. *Industry and Welding,* v. 20, May 1947, p. 40-41, 44, 46, 48.

Welding as applied to diesel engines and diesel locomotives. Welding organization and flow diagrams; flame cutting and hardening.

22-255. Some Observations on Chipping and Scarfing Operations. Part II. Ralph D. Hindson. *Blast Furnace and Steel Plant,* v. 35, May 1947, p. 553-557.

In technique known as hand scarfing, operator, wielding an oxy-gas torch, burns surface defects off steel plate. Considerable skill is required. Relative merits of chipping and of hand scarfing. Applicability of hot deseamers, which skin all four sides of the bloom or billet during rolling, and of mechanical chipping.

22-256. Worn Mill Rolls Rebuilt by Welding 6½ Tons on Work Face. *Iron Age,* v. 159, May 22, 1947, p. 80.

How approximately 6½ tons of alloy steel was deposited on the working face of a scrap-backup roll from a continuous hot strip mill at Jones & Laughlin's Pittsburgh works.

22-257. Welding Power Piping With Chromium-Molybdenum Electrodes. Orville T. Barnett. *Steel,* v. 120, May 26, 1947, p. 88-90, 125, 128, 130.

Specifications and techniques for the use of four basic electrode types in analyses ranging from 0.5 to 3.0% Cr and 0.5 to 1.0% Mo which are now being used for the welding of high-pressure, high-temperature piping.

22-258. Pressure Welding of Light Alloys Without Fusion. R. F. Tylecote. *British Welding Research Association,* Jan. 1946, 16 p.

Attempts to weld overlapping sheets of nine aluminum and three magnesium alloys by simultaneous application of heat and pressure at temperatures below their melting points. An aluminum alloy containing magnesium and silicon in the proportions of Mg_2Si, a duralumin type alloy, and an aluminum alloy containing 1¼% manganese, gave the best results. Effective cleaning of the surfaces was very important.

22-259. The Cause of the Rubber-Brass Bond. C. M. Blow. *India-Rubber Journal,* v. 62, April 26, 1947, p. 3-4, 6-7.

Experimental evidence to support the theory that the bonding of rubber to brass is primarily due to the catalytic action of the copper in producing oxidation or other products of the rubber which show specific adhesion to metal.

22-260. Progress Report on Preliminary Investigation of Metal-Bonded Ceramics. A. R. Blackburn and T. S. Shevlin. *Headquarters Air Materiel Command Technical Report No. 21,* May 1947, 32 p.

Equipment and techniques used in work being done at Ohio State University. Preliminary data on two combinations of silicon carbide and metal, and on 12 combinations of alumina and metal.

22-261. Proper Handling of Gas Welding Equipment. C. C. Hermann. *Power Plant Engineering,* v. 51, May 1947, p. 86-87.

Cleaning of torch tips; proper method of adjustment of connection nuts on welding torches; correct way to adjust gas-oxygen mixture.

22-262. Spot Welding of Primary Structures. *Steel,* v. 120, May 19, 1947, p. 88, 128.

Process as developed at Boeing Aircraft.

22-263. Stainless Steel Cutting. Howard G. Hughey. *Welding Journal,* v. 26, May 1947, p. 393-399.

The development of methods for the above. The technique of various methods and each evaluated. Recommends the "flux-injection" method for both mechanical and hand cutting.

22-264. Submerged Melt Welding in Pressure Vessel Fabrication. N. G. Schreiner. *Welding Journal,* v. 26, May 1947, p. 400-407.

Joint preparation and fabrication techniques for different joint designs for pressure vessels using the Unionmelt process.

22-265. Production Applications for Inert-Gas Shielded-Arc Welding. H. T. Herbst. *Welding Journal,* v. 26, May 1947, p. 410-418.

Principles and applications of heliarc welding.

22-266. Automatic Oxy-Acetylene Operations. R. F. Helmkamp. *Welding Journal,* v. 26, May 1947, p. 419-425.

Ways in which oxygen cutting can be used to speed up or improve miscellaneous metal-industry operations, other than the usual plate cutting.

22-267. Three-Phase Balanced-Load Resistance Welding Machines. J. L. Solomon. *Welding Journal,* v. 26, May 1947, p. 426-431.

Electrical circuits and controls and advantages over single-phase equipment.

22-268. Some Tests of Large Welded Structures. E. Paul DeGarmo. *Welding Journal,* v. 26, May 1947, p. 257s-267s.

Details of an extensive investigation of full-scale welded structures conducted for the U. S. Navy to aid in welded-ship design. Effects of weld preheating and postheating and of several different electrodes, as well as different designs.

22-269. Optimum Welding Conditions and General Characteristics of Spot Welds in Magnesium Alloy Sheet. W. F. Hess, T. B. Cameron, D. J. Ashcraft, and F. J. Winsor. *Welding Journal,* v. 26, May 1947, p. 268s-282s.

Test and examination methods. Optimum conditions were determined for each of the commercially available compositions of Mg alloy sheet in selected tempers and gages after chemical surface preparation. Physical properties of the welds for each material under optimum conditions, and the effects of different welding conditions. 18 ref.

22-270. The Inert-Gas Shielded-Arc Welding Process. Glenn J. Gibson. *Welding Journal,* v. 26, May 1947, p. 282s-294s.

An investigation of the use of the process for welding of stainless steel and other metals. Specific objectives

(Turn to page 42)

Mechanical & Experience Factors Dominate In Choice of Steels

"Selection of Steel for Engineering Applications" was the subject discussed before the Hartford Chapter ⊕ recently on "Past Chairman's Night". The speaker, Gordon T. Williams, materials engineer, Pratt & Whitney Aircraft Division of United Aircraft Corp., emphasized the mechanical and experience factors that dominate in the choice of steel.

The metallurgist cannot expect the engineer to understand the metallurgical implications involved in selection of steel for a job; rather, the metallurgist must bend every effort to understand the mechanics and other aspects involved so that he may present the facts to the engineer as necessary to permit proper choice. Steel for a given job is usually selected by knowledge of past performance of similar parts, so that accurate service records and careful analysis of failures are essential to future improvements.

Resistance to deformation (yield and tensile strength) and ability to deform (ductility) are shown by ordinary physical tests on steels, but failures from inadequacies in these respects are relatively infrequent, most service troubles being the result of repeated loads in operation. Wear, a frequent reason for failure, is usually best counteracted by high hardness. Fatigue failures are common, and, although endurance life of test bars is a function of ultimate strength, the presence of designed or accidental stress-raisers can invalidate the most carefully chosen steel.

Heat treatment reliability is very important, and Mr. Williams emphasized the value of the Jominy hardenability test, stating that without its development the use of alternate steels during the war would have been severely handicapped. Chemistry of the steel, he said, is of relatively minor importance.

Availability, adaptability of the steel to normal processing in the shop, without necessity for special handling, control of such shop operations as heat treating and grinding, are all factors which help to determine the most reasonable steel to specify. In conclusion, Mr. Williams called attention to the basic consideration in choosing the steel for a specific application—namely, the lowest cost of a satisfactory product in the hands of the customer.

Past Chairman Gets Certificate

John A. Swift Was Awarded an A.S.M. Certificate at Past Chairmen's Night of the Hartford Chapter. Left to right are William W. Wight, secretary-treasurer; Mr. Swift; Gordon T. Williams, technical speaker; Ovide G. Hogaboom, chairman; and Daniel A. Tullock, vice-chairman

Oil Refinery Inspection Precedes Talk on Copper

Reported by Louis Malpoker

Lincoln Engineering Co.

An inspection trip to the Wood River Refinery of the Shell Oil Co. preceded the regular meeting of the St. Louis Chapter ⊕ on April 17. Members were conducted about the 500-acre plant by guides who explained each step in the refining of gasoline and oil.

Following dinner at the Mineral Springs Hotel in Alton, John H. Reese, technical advisor, Revere Copper and Brass, Inc., Chicago, spoke on "Some Practical Aspects of Engineering With Copper and Its Alloys".

Copper will alloy with a wide number of elements, Mr. Reese pointed out, and the field of application is endless and economical. Most failures in copper and copper alloys are due to improper design and corrosion.

Slides were shown to explain the deep drawing, spinning, bending, and forming processes, and the extrusion of copper billets into tubing. Mr. Reese's talk was preceded by a motion picture taken at the Revere plant.

were to determine the design basis for the necessary apparatus, to determine fundamental welding characteristics and limits of application, particularly for stainless steel, and to compare helium and argon as shielding gases. Coverage is limited to direct-current straight-polarity welding.

22-271. Residual Stresses in Welded Structures. Wilbur M. Wilson and Chao-Chien Hao. *Welding Journal*, v. 26, May 1947, p. 295s-320s.

An analysis was developed for determining the residual stresses produced when two plates are joined by a longitudinal weld, and two series of tests were made to verify this analysis. For both series, residual stresses were determined experimentally by the method of relaxation.

22-272. Metallic Joining of Light Alloys. *Light Metals*, v. 10, May 1947, p. 214-223.

Application of electrical fusion to the joining of aluminum wire and strip; survey of the patent literature on some typical apparatus. (To be continued.)

22-273. The Gluing of Light Metals. *Light Metals*, v. 10, May 1947, p. 234-241.

Numerous applications of metal-to-metal and nonmetal joints using synthetic resin adhesives, especially in aircraft construction.

22-274. How Atomic-Hydrogen Arc Welding Aids Production. R. F. Wyer. *Steel Processing*, v. 33, May 1947, p. 287-289, 307.

Factors which contribute toward speed when atomic-hydrogen arc welding is utilized. Instances where this type of welding is especially effective. Special features of joints to be welded by atomic-hydrogen arc. Method of welding and equipment.

22-275. "Fastener Engineering" in Product Assembly. *Steel Processing*, v. 33, May 1947, p. 290-293.

The development of miscellaneous fastening devices for thin-gage sheet metal. Holes are formed in such ways that the screws used are held in place without nuts.

22-276. An Aluminum Solder That Requires No Flux. *Materials & Methods*, v. 25, May 1947, p. 81-82.

Some of its uses. Test results covering melting properties, soldering operation, shear tests, electrical resistance, effect of vibration, and a preliminary investigation of corrosion. All tests were conducted on joints between two pieces of 3S½H aluminum alloy, and between this metal and one-half hard muntz metal (60% copper, 40% zinc).

22-277. Spot Welding in Aircraft Manufacture. Frederick S. Dever. *Materials & Methods*, v. 25, May 1947, p. 92-96.

Design of parts to be welded; materials to be spot welded and their preparation for spot welding.

22-278. Precision Energy-Storage Spot Welder. Rufus Briggs and Hans Klemperer. *Electronics*, v. 20, June 1947, p. 102-104.

Technical details of a compact capacitor-type spot welder for light-gage sheet metal and wire. A tube-controlled 200-microfarad storage bank provides a maximum storage-energy level of 225 watt-seconds. Tubes also terminate the discharge and block line power.

22-279. Welding Magnesium Alloys. *Aluminium & the Non-Ferrous Review*, v. 12, Jan-March 1947, p. 12-13.

Techniques, cleaning, filler rods, preheating.

22-280. Determination of the Permissible Oxygen Excess in the Oxy-Acetylene Flame. F. Bohler. *Engineers' Digest (American Edition)*, v. 4, May 1947, p. 224.

The equilibrium of the parts of the flame and the weld metal; the graphical determination of the mixing ratio for neutral flames; the decomposition pressures of metal oxides; and the use of a graph of both the partial oxygen pressure of the flame and decomposition pressure of the metal oxides plotted against the reciprocal of the absolute temperature. (Translated and abstracted from *Zeitschrift für Schweisstechnik*, v. 36, Aug. and Sept. 1946, p. 169-175, 191-195.)

22-281. The Performance Ratio of the Blowpipe Flame With Leftward and Rightward Welding. F. Bohler. *Engineers' Digest (American Edition)*, v. 4, May 1947, p. 239-241.

Forward technique is called leftward and backward is called rightward in this article. Rightward welding has been shown to be superior by practical welding tests. This conclusion is confirmed by a theoretical analysis. (Translated and condensed from *Zeitschrift für Schweisstechnik*, v. 36, Dec. 1946, p. 246-253.)

22-282. The "Cookson" Lock Joint. W. Cookson. *Sheet Metal Industries*, v. 24, May 1947, p. 985-988, 998.

A new type of joint for sheet metal assembly. This lock joint is a complete departure from conventional assembly methods, in that its components are made integral with the sheets to be joined, using a simple adaptation of an ordinary folding machine.

22-283. The Welding of Nonferrous Metals. Part VIII. The Welding of Copper and Its Alloys. (Continued.) E. G. West. *Sheet Metal Industries*, v. 24, May 1947, p. 1017-1023, 1027.

Welding of copper-zinc-alloy and arc and resistance welding of brasses. Properties of brass welds.

22-284. Spot Welding of Light Alloys. Present Trends in American Machine Design. T. M. Roberts. *Sheet Metal Industries*, v. 24, May 1947, p. 1028-1032, 1034.

The roller spot welding machine. Storage battery spot welding machine. Sciaky three-phase to single-phase conversion system. (Papers presented at British Welding Research Assoc. Symposium.)

22-285. Refrigerator Assembly. *Welding*, v. 15, May 1947, p. 195-203.

The use of various welding processes at new refrigerator factory in England.

22-286. Jointing of Brass. Edwin Davis. *Welding*, v. 15, May 1947, p. 204-213.

A survey of methods and applications.

22-287. Resistance Welding in Mass Production. A. J. Hipperson and T. Watson. *Welding*, v. 15, May 1947, p. 214-223.

The arrangement of different types of jigs and fixtures for spot welding including those for multi-spot work.

22-288. Oxygen Cutting. E. Seymour Semper. *Welding*, v. 15, May 1947, p. 224-226.

Special machine installations.

22-289. Bench-Welded Watch Springs. Clyde B. Clason. *Welding Engineer*, v. 32, June 1947, p. 40-42.

Use of spot welding in assembly of Elgin's "Elgiloy" mainsprings. Spot-welded joints were found to be twice as strong as riveted ones.

22-290. Torch Brazing Aluminum. Part II. Harry Huff. *Welding Engineer*, v. 32, June 1947, p. 45-47.

The four major steps in the torch brazing of aluminum; production methods, and a list of products which may be fabricated by this method.

22-291. Bending and Welding Pipe Coils. M. G. Hawkins. *Welding Engineer*, v. 32, June 1947, p. 48-49.

Methods and equipment used by Olympic Pipe Fabricating Co., Seattle, which makes a specialty of prefabricated marine piping installations.

22-292. New Design for A.C. Welders. Arthur Simon. *Welding Engineer*, v. 32, June 1947, p. 50-52.

A novel a.c. welding transformer devised by a Swiss inventor. One of its advantages is that the arc is established promptly at points of zero current.

22-293. Portable Trailer for Inert-Gas Shielded-Arc Welding. *Welding Engineer*, v. 32, June 1947, p. 54.

Outfit built by engineers of the Aluminum Co. of America's welding section for the purpose of welding together aluminum electrical conductors during the construction of new plants.

22-294. Trade Names of Resistance Welding Electrode Alloys and Resistance Welder Manufacturers' Assoc. Specifications. *Welding Engineer*, v. 32, June 1947, p. 69.

In tabular form.

22-295. Welding. Its Implications and Applications. Paul Weidlinger. *Progressive Architecture*, v. 28, June 1947, p. 79-83.

Advantages and limitations of welding in the joining of structural steel for buildings. (To be concluded.)

22-296. Preventive Measures Reduce Welder Upkeep. C. A. Lehton and H. F. Worcester. *American Machinist*, v. 91, June 5, 1947, p. 118-119.

Maintenance procedures at Ryan Aeronautical Co.

22-297. The New Bridge Over the Seine at Saint-Cloud. *Welder*, v. 16, Jan-March 1947, p. 8-13.

Design principles, welding sequences and calculations, properties of steel used, girder fabrication, and erection procedures for new all-welded bridge. (Translated and condensed from *L'Ossature Metallique*, July-Aug. 1945.)

22-298. Fabrication of All-Welded Landing Craft. *Welder*, v. 16, Jan-March 1947, p. 14-18.

Illustrated by many photographs.

22-299. The Fabrication of Framed Structures in High-Tensile Structural Steel by Welding. R. Digby Smith. *Welder*, v. 16, Jan-March 1947, p. 18-23.

Requirements and difficulties encountered in the construction of military bridges which distinguish them from other bridges. Special requirements are portability, simplicity of assembly, and considerable elasticity in regard to loads, spans, and supports.

22-300. Automatic Metallic-Arc Welding Hot Water Tanks. *Steel*, v. 120, June 9, 1947, p. 94, 98.

Methods used at the Detroit plant of Ferro Stamping & Manufacturing Co.

22-301. Automatic Welding of Steel Hinges. *Machinery*, v. 70, May 15, 1947, p. 515-516.

Use of Lincolnweld automatic metallic-arc equipment for welding door hinges.

22-302. Welded Ship Fractures. E. C. Kreutzberg. *Steel*, v. 120, June 16, 1947, p. 120, 122.

Investigation Board report indicates that the fractures in welded ships were caused by notches built into the vessels, either through design or as the result of workmanship practices, and by steel which was notch sensitive at operating temperatures.

22-303. Flash Welding Tubular and Solid Parts for Lockheed Planes. Fred C. Pipher. *Machinery*, v. 53, June 1947, p. 160-163.

Technique used in permanently joining alloy steel members by welds that must be 95% as strong as the parent metal.

22-304. Electronically Controlled Tracing Head. *Product Engineering*, v. 18, June 1947, p. 102-103.

Details of system used to control automatic oxy-acetylene cutting torches. The control head follows an outline drawing on paper.

For additional annotations indexed in other sections, see:
4-61; **11**-60; **12**-93-99; **15**-19-20; **19**-178; **23**-173-175-187-189; **24**-147-155-162-166-169.

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Joining Methods for Thin Metal Compared on Cost Basis

"Joining of Light-Gage Metals" was discussed from the very practical aspects of cost of equipment and processing, and efficient technical operation, when H. Thomasson, metallurgical engineer of Canadian Westinghouse Co., Ltd., addressed the Western Ontario Chapter ⊕ recently. Mr. Thomasson showed slides of the various processes for joining thin metals, comparing them from the standpoints of labor and equipment costs, speed of operation, and joint design suitable for each type of welding.

The oxy-acetylene process Mr. Thomasson characterized as the oldest, best known and most universal of all welding processes. It is the only one that takes all metals in its stride and is just as much at home on cast iron as on low carbon sheet steel.

Arc welding is not often thought of as a good way to weld very light sheet metals (say, under 0.050 in. thick), but under production conditions with good fixtures it does an excellent job. Its advantages are relatively low equipment cost, a gas and liquid-tight joint, minimum distortion and relatively high speeds. To obtain these advantages requires care in fixture design so that the parts are securely held.

Spot welding and its associated processes of pulsation, projection and seam welding are the most used and least understood of all the sheet metal welding processes, Mr. Thomasson believes.

A spot weld acts like a rivet; it can be used wherever riveting would provide a satisfactory joint and do it at from a tenth to a twentieth of riveting costs.

The introduction of electronic control of timing and closing spot welder circuits with absolute accuracy has made it possible to weld metals previously undreamed of, according to Mr. Thomasson. These include lead down to 0.010 in. thick and aluminum as low as 0.005 in. There are few combinations of dissimilar metals that cannot be spot welded, even such unusual combinations as galvanized iron to aluminum.

Automatic brazing provides two fully automatic processes for joining light-gage metals—induction brazing and controlled atmosphere furnace brazing. These have much in common, although the induction process uses somewhat less expensive equipment than the furnace process and at the same time is less versatile. Controlled atmosphere furnace brazing has a much greater range of products and only a fraction of the size limitations of induction brazing.

Sustaining Members Hear About Sustaining Metals

Reported by John W. Sweet

Chief Metallurgist, Boeing Aircraft Co.

The 26 sustaining members of the Puget Sound Chapter ⊕ were honored at the May meeting in appreciation for their support. These companies have made it possible for the chapter to offer educational opportunities in the field of metals to members and others.

Following a short talk on the history of the Puget Sound Chapter by Ralph Winship, chapter chairman, the principal speaker of the evening, Joseph Daniels, professor of mining engineering and metallurgy at the University of Washington, gave a lecture on "Sustaining Metals".

Professor Daniels considered the base metals such as iron, copper, tin, aluminum and magnesium as being sustained or supported by their alloying constituents. The metals discussed were barium, beryllium, boron, bismuth, cadmium, calcium, cobalt, columbium, lithium, manganese, molybdenum, selenium, silicon, titanium, tungsten, uranium, vanadium and zirconium. He discussed the metals in their original ores, how they are refined, and their common properties.

At the conclusion of his talk, Professor Daniels spent an interesting few minutes covering the history of the American Society for Metals.

23 INDUSTRIAL USES and Applications

23-159. The Silver Side of Lithium. J. D. Clark and L. G. Bliss. *Foote Prints*, v. 18, no. 2, 1947, p. 3-12.
Development of the use for lithium compounds in industry and how Foote became associated with transitional elements and their ores. Physical and chemical characteristics of lithium.

23-160. The Use of Zirmet for Gas Absorption. W. M. Raynor. *Foote Prints*, v. 18, no. 2, 1947, p. 22-24.
Properties, processing methods, and applications of zirconium produced by Foote Mineral Co. for use as a getter in electronic tubes.

23-161. Automatic Folding and Grooving Machines for the Manufacture of Cans. *Machinery Lloyd*, v. 19, April 26, 1947, p. 98-101.
Operating and construction details of machine built in three sizes and capable of seaming 2,000 can bodies per hour.

23-162. New Materials and New Uses for Old Materials. Milton Male. *Blast Furnace and Steel Plant*, v. 35, May 1947, p. 560-562, 570.
Some recent metallurgical and metal-product developments. Steel for housing; light-gage structural steel.

23-163. All-Aluminum Prefab. *American Lumberman & Building Products Merchandiser*, May 10, 1947, p. 76.
Prefabricated home made by Southern States Iron Roofing Co.

23-164. Aluminum Roof Trusses for an Enginehouse. *Engineering News-Record*, v. 138, May 15, 1947, p. 98-99.
Structural steel roof trusses, corroded to the point of failure by locomotive gases, were replaced by all-aluminum, shop-fabricated trusses in the Alton & Southern R. R. enginehouse at East St. Louis, Ill. To retard future corrosion the new trusses received one coat of zinc chromate paint and two coats of aluminum.

23-165. Vital Organ of the Ship. *Inco*, v. 21, no. 2, 1947, p. 4-7.
Copper alloys for condenser tubes used in ship boilers.

23-166. Costs Cut 30 to 35% by New Clad Strip. *Inco*, v. 21, no. 2, 1947, p. 11-12.
Properties and applications of monel or nickel-clad strip developed by Superior Steel Corp., Carnegie, Pa. It is made with cladding on one or both sides.

23-167. Low-Cost Corrosion Protection. *Inco*, v. 21, no. 2, 1947, p. 22.
Use of nickel-molybdenum cast iron for corrosion-resistant valve in tide-water power plant.

23-168. Three Times the Life on a Diet of Sand. *Inco*, v. 21, no. 2, 1947, p. 28-29.
Propeller shafts on river dredges are protected by monel sleeves for resistance to corrosion and abrasion.

23-169. Riverside Weddings. *Oilways*, v. 13, May 1947, p. 1-7.
Production of specialty nonferrous alloys at Riverside Metal Co., Riverside, N. J.

23-170. Manufacture, Selection and Use of Files. Part II. L. E. Browne. *Steel*, v. 120, May 19, 1947, p. 90-92, 130, 132.
Speeds, wear and cost that can be expected, and filing techniques generally used for best results. (To be concluded.)

23-171. Copper and Brass for Jewelry and Its Accessories. *Copper and Brass Bulletin*, May 1947, p. 1-16.
Entire issue consists of an illustrated article on the above subject.

23-172. Magnesium Alloys. T. C. Du Mond. *Materials & Methods*, v. 25, May 1947, p. 99-114.
The most frequently used magnesium alloys and the most satisfactory means of fabricating them into finished products. Available forms; joining; machining; forming and bending; cleaning and finishing; design considerations.

23-173. Fabrication Notes on Corrosion Resistant Alloys. J. C. Holmberg. *Steel Processing*, v. 33, May 1947, p. 285-286, 293.
Problems involved in the fabrication of the two types of stainless steel most commonly used in pressure vessel work—the ferritic and the austenitic. Pickling, heat treatment, working, and welding.

23-174. Steel and Plastics. E. T. Gill. *Iron and Steel*, v. 20, May 1947, p. 185-188.
Materials used for molds and hobs in the plastics industry.

23-175. Washer Bases Fabricated From Sheet. Kenneth F. Brooks. *American Machinist*, v. 91, May 22, 1947, p. 110-112.
Pressing and welding procedures at Nineteen Hundred Corp.

23-176. Specific Industries Show German Production Problems. John Christie. *American Machinist*, v. 91, May 22, 1947, p. 137-140.
Metalworking situation in Germany in specific key industries. Production operations on the Volkswagen, only passenger car produced since the war.

23-177. The New Wear Bridge. F. J. Walker. *Light Metals*, v. 10, May 1947, p. 224, 227-228.
The development of bridge design and construction from the time of the earliest timber assembly to the latest project—an aluminum-alloy drawbridge.

23-178. Home Front Surveyed. *Light Metals*, v. 10, May 1947, p. 243-255.
Numerous new applications of aluminum to kitchenware, bottle crates, tools.

23-179. Aluminum as a Reflector. *Light Metals*, v. 10, May 1947, p. 256-262.
A study of the light-reflective properties of a series of metals for the various spectral regions. Superiority of aluminum, especially when properly finished, as a reflector material for infrared, visible, and ultraviolet radiation. (To be continued.) 17 ref.

23-180. From Planes to Caskets. *Western Metals*, v. 5, May 1947, p. 26-27.
Assembly-line production of chromium nickel alloy caskets at Ryan Aeronautical Co.

23-181. Pacific Division, Bendix Aviation Corp. *Western Metals*, v. 5, May 1947, p. 22-25.
Picture story of production methods.

23-182. Getting Squared Away With Stainless. *Modern Industry*, v. 13, May 15, 1947, p. 49-52.
Examples of new design and fabrication ideas; how to adapt them to plant and product.

23-183. Why More Lead Production Is Needed. Felix E. Wormser. *Mines Magazine*, v. 37, April 1947, p. 19-20, 36, 38.
Storage batteries and electric cables use most of the lead. The need for more production of white lead. Uses of lead in paints, plumbing, hospitals, alloys, gasoline, and insecticides.

23-184. Piston-Ring Production. J. A. Oates. *Aircraft Production*, v. 9, May 1947, p. 192-199.
Developments in design; materials and methods; processes used by Wellworthy Piston Rings, Ltd.

23-185. Aluminum for Air Ducts. (Continued.) G. W. Birdsall. *Sheet Metal Worker*, v. 38, May 1947, p. 49-52.
Recommendations for alloys, tempers, thicknesses and sizes, as well as handling, fabrication, and erection procedures.

23-186. Structural Application of 75S-T. George Snyder and Frank J. Crossland. *Light Metal Age*, v. 5, May 1947, p. 6-8, 10.
Properties of 75S-T in terms of its advantages and limitations for aircraft structures.

23-187. Welded-Boiler Locomotives on Canadian Pacific Railway Lines. *Engineers' Digest (American Edition)*, v. 4, May 1947, p. 243.
Advantages over riveted construction shown by tests. (Abstracted from *Engineering Journal (Canada)*, v. 29, Dec. 1946, p. 717-719, 723.)

23-188. Materials for High-Temperature Piping. *Heating, Piping & Air Conditioning*, v. 19, June 1947, p. 90-91.
Use of chromium-molybdenum steels for high-temperature steam piping.

23-189. Housing on an Assembly Line. A. N. Carter. *Welding Engineer*, v. 32, June 1947, p. 35-39.
Manufacture and assembly of steel-frame prefabricated dwellings.

23-190. Unique Machinery Facilitates Production of Body Hardware. Joseph Geschelin. *Automotive and Aviation Industries*, v. 96, June 1, 1947, p. 38-40.
Use of unique fabrication and polishing machinery, and material-handling devices, combined with a plant layout emphasizing straightline manufacturing departments for each type of product, at Fisher Body's Ternstedt Division, Detroit plant.

23-191. Some Experiments With Tungsten Carbide Tipped Drill Steel. J. H. Bloemsma, R. Ramsay, and O. Deane. *Journal of the Chemical, Metallurgical and Mining Society of South Africa*, v. 47, Jan. 1947, p. 243-275; discussion, p. 275-283.
Experiences with different drill-bit designs in different ores.

23-192. Steam Turbines for Iron and Steel Works. I. V. Robinson. *Journal of the Iron and Steel Institute*, v. 156, May 1947, p. 81-89.
Possible future developments. Design recommendations.

23-193. Aluminum Aircraft Skis. *Modern Metals*, v. 3, May 1947, p. 20-21.
The development of aircraft skis by Federal Aircraft Works.

23-194. The Precipitron Utilizes Aluminum. *Modern Metals*, v. 3, May 1947, p. 22-23.
One of the most important features of the new Westinghouse Electric precipitron is the aluminum dust-collecting cell. How the precipitron works, early developments, and some typical successful installations.

23-195. Aluminum Shower Cabinet. *Modern Metals*, v. 3, May 1947, p. 24.
New application of aluminum.

23-196. Models From Magnesium. *Modern Metals*, v. 3, May 1947, p. 25.
Airplane models, furniture, bridges, are built using kit now on the market.

23-197. Composite Materials Attract Designers of Lighter Structures. *Steel*, v. 120, June 9, 1947, p. 76-79, 98, 100.
Use of metal-to-wood laminates—hard plywood cores singly or doubly faced with a choice of metals in architecture of modern high-speed trains, truck and trailer bodies, commercial furniture, escalators and industrial equipment.

23-198. Bushings From Steel Wool Made by North American Aviation. Charles O. Herb. *Machinery*, v. 53, June 1947, p. 164.
These unique bushings are impregnated with copper completely throughout their structure, and at the same time, are assembled by brazing into landing-gear struts.

23-199. Production of New Motor. *Steel*, v. 120, June 16, 1947, p. 90-92, 109.
Specialized manufacturing techniques used in Fairbanks-Morse's Freeport plant. Axial air-gap design makes motor easily adaptable to machine tools, gear units and other equipment where compactness and modernized appearance are essential.

23-200. Steel Mills Are Large Users of Manganese Steel. *Edgar Allen News*, v. 25, May 1947, p. 825-826.
Some of the types of manganese steel castings used by the steel industry.

23-201. Toolsteels. Part V. L. Sanderson. *British Steelmaker*, v. 13, May 1947, p. 246-249.
Concludes section on toolsteel con-

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Metal Cutting Experiments Revealed

Studying Professor Trigger's Formula for Metal Cutting Temperature Are (Left to Right) L. J. Ely, Technical Chairman of the Meeting; D. J. Wright, Peoria Chapter Chairman; Professor Trigger; and C. A. Davis, Chairman of the Central Illinois Section of A.S.M.E. in a Joint Society Meeting

Reported by A. G. Phillips

Caterpillar Tractor Co.

Experiments carried out by Prof. K. J. Trigger of the department of mechanical engineering, University of Illinois, shed new light on metal cutting temperatures, it was revealed before a joint meeting of the Peoria Chapter ⊕ and the Central Illinois Section of the American Society of Mechanical Engineers.

Concentration of heat at the tool surface is one of the prime causes of tool failure, Professor Trigger told his audience. He and his associates measured this temperature by using the cemented carbide tool and the work as the two dissimilar metals of a thermocouple, and determining the potential between them. The work and the tool were insulated except at the work face, which served as the hot junction. The work-tool thermocouple was calibrated against a standard chromel-alumel thermocouple in a furnace.

One of the tests run by Professor Trigger was to determine the effect of cutting speed on the temperature at the tool chip contact. When this temperature was plotted against cutting speed on log paper the curve was found to be a straight line.

This means that the two variables are related by a mathematical equation involving two constants, namely,

$$T = CV^n$$

where T is the cutting temperature in degrees Fahrenheit, C a constant, V the cutting speed, in surface feet per minute, and n the exponent. The constant C and exponent n may be related to the machinability of the work.

Although the experimental technique has some limitations, Professor Trigger feels that it nevertheless offers possibilities for future investigations on machinability.

Alloy Rods Appoints Lee

Richard K. Lee has been named technical director for Alloy Rods Co., York, Pa. Mr. Lee, a graduate of Ohio State University, has over 10 years' experience in the welding field. He spent five years as research assistant and engineer at the Steel and Tube Division of the Timken Roller Bearing Co., and during the last six years has been with Alloy Rods as research engineer on arc welding electrodes, welding metallurgy and quality control in the production of electrodes.

Electro-Alloys Opens New Plant

The new plant of the Electro-Alloys Division of American Brake Shoe Co. at Elyria, Ohio, is expected to be ready for full production about Aug. 1, at which time the heat resistant alloy production of the American Manganese Steel Division will be transferred to Elyria. Walter G. Hoffman ⊕, president of the Electro-Alloys Division, has already moved his office from Chicago Heights, Ill., to the new plant.

taining manganese, silicon, vanadium, and molybdenum. A steel containing tungsten, chromium, and vanadium. Properties, applications, and fabrication techniques. (To be continued.)

23-202. Stainless Steel for Springs. Part II. Harold C. R. Carlson. *Product Engineering*, v. 18, June 1947, p. 153-156.
Allowable working stresses, commercial tolerances, heat treatments, current prices, and other data useful in determining the proper type of stainless steel for spring applications.

For additional annotations indexed in other sections, see:
3-152-163-164; **5**-42; **12**-91; **19**-187; **20**-262-281-294; **22**-266-289-295-298; **27**-115.

24 DESIGN

24-144. Stress Analysis Research by Means of Brittle Coatings. August J. Durelli. *Frontier*, v. 10, March 1947, p. 7-9.
Techniques used.

24-145. The Equilateral Electric Strain Gage Rosette. Given Brewer. *Metal Progress*, v. 51, May 1947, p. 758-763.
A simplified graphical method in which three electric strain gages are arranged regularly about a point, giving an accurate estimate of the principal stresses and their directions.

24-146. Torsion Bar Springs. *Metal Progress*, v. 51, May 1947, p. 771-774.
Some metallurgical and design details showing how the spring designer and spring maker have combined the advanced knowledge of elastic action in hardened and overstressed steel to improve greatly the operating characteristics of heavy, track-laying vehicles, such as tanks and gun carriages.

24-147. Fourth Interim Report on the Investigation of the Welding of Ships' Structures. James Turnbull. *British Welding Research Association*, Aug. 1945, 3 p.
Results of 47 additional tests covering 12-in. bulb angles and 12-in. bulb plates with different types of bracket connection; and 12-in. tee stiffeners of different designs. Stress distributions, design details of specimens, and deflections under various loads.

24-148. A Moment Distribution Method for Rigid Frame Steel Structures Loaded Beyond the Yield Point. M. R. Horne. *British Welding Research Association*, Jan. 1946, 8 p.
Method for computing stresses due to flexure in a rigid steel frame, after the yield stress has been exceeded in a certain number of its members. Formulas are developed showing the joint rotations, stiffness factors, carryover factors, and joint translation factors for a beam of rectangular cross section at any stage of plastic deformation. A method for calculating the stresses in a steel frame which has been stressed beyond the elastic limit, and then unloaded, or reloaded with differing load concentrations.

24-149. Form Tools. (Continued.) William F. Walker. *Edgar Allen News*, v. 25, April 1947, p. 809-810.
Design of circular form tools. (To be continued.)

24-150. Drawing Die Problems and Formulas. Installment No. 2. James Walker. *Tool Engineer*, v. 18, May 1947, p. 18-23.
Sectional blank die construction; "breaking" the die; taper considerations; dinking dies; shallow draw and trim; forming and parting dies; die for press brake; two-stage forming die; operation of press brake for corrugating; two-stage hinge die. (To be continued.)

24-151. Weight Economy in Engineering Design. Walter A. Semmion. *Materials & Methods*, v. 25, May 1947, p. 59-62.
How choices of materials and designs based on the principles of weight economy can result in a much more efficient product and help reduce manufacturing costs.

24-152. Designing of "Trouble-Free" Dies. Part LXIX. C. W. Hinman. *Modern Industrial Press*, v. 9, May 1947, p. 20, 30.
Assembling of sheet metal parts.

24-153. Specifications and Method of Dimensioning Screw Holes and Washers for Broach Inserts and Holders. *Western Metals*, v. 5, May 1947, p. 36.
Shown diagrammatically.

24-154. Allowances for 90° Bends in Sheet Steel. Parts III and IV. Alf J. Abrahamsen. *American Machinist*, v. 91, May 22, 1947, p. 155, 157.
Cutting sizes of sheet steel for various combinations in 10 to 24 gage material.

24-155. Roof Trusses With Welded Joints Tested by Jacking Against Each Other. *Engineering News-Record*, v. 138, May 29, 1947, p. 52-53.
Novel test program designed to determine the reliability of all-welded trusses used to support the roofs of General Electric's new research and manufacturing center near Syracuse, N. Y.

24-156. Designing Tools for Screw Machine Production. Part IX. C. W. Hinman and A. H. Adams. *Screw Machine Engineering*, v. 8, May 1947, p. 57-59.
Step corrections for circular tools; and top rake calculations for circular form tools.

24-157. Production of Hydraulic Equipment. Part I. *Aircraft Production*, v. 9, May 1947, p. 163-166.
British-made device used for aircraft hydraulic systems utilizes the compressibility of liquids at very high pressures—approx. 30,000 psi. Machining techniques used in its fabrication. (To be concluded.)

24-158. Some Experiments on the Distribution of Deflection and Stress in Thin Flat Plates Subjected to Practical Systems of Loading. (Concluded.) H. D. Conway and V. C. Davies. *Sheet Metal Industries*, v. 24, May 1947, p. 993-997, 999.
From experiments on a uniformly loaded square plate on a single central support it was concluded that maximum deflection could be found approximately by treating the plate as a circular plate loaded with the same pressure and having the same diameter as the diagonal of the square plate. For a uniformly loaded square plate on four equidistantly spaced supports, minimum deflection was obtained when the center corner and midside deflections were the same.

24-159. The Design of Compound Cylinders for High-Pressure Service. W. R. Manning. *Engineering*, v. 163, May 2, 1947, p. 349-352.
Equations for use in the design of cylindrical high-pressure vessels. Results of the theoretical analysis are applied to a consideration of the A. O. Smith "Multi-Layer" system of construction. Results of tests on two of these vessels indicate little or no increase in ultimate strength compared to the simple cylinder, although the elastic strength is considerably improved.

24-160. Stress Concentration and Fatigue Failures. S. Timoshenko. *Engineer*, v. 183, May 9, 1947, p. 398-399; May 16, 1947, p. 421-422.
The various ways for reducing fatigue failure are illustrated by example of locomotive axles. (Condensed from paper presented at Institution of Mechanical Engineers, April 25, 1947.)

24-161. Stress Analysis by Polarized Light. *Engineer*, v. 183, May 23, 1947, p. 454-455.
Principles and methods applied in use of a British-made instrument for determining stress concentrations of parts. Application to gears.

24-162. Welded Tank Fails at 960 Psi. *Welding Engineer*, v. 32, June 1947, p. 60.
Results of destructive test on a 24-in. cylindrical butane storage tank.

24-163. Unveil Plane Wheel Service Stresses With Laboratory Stresscoat Analysis. *SAE Journal*, v. 55, June 1947, p. 26-28, 32.
A quick method of determining stress by a combination of dynamic loading and brittle lacquer coating leads to improved design of airplane wheels and brakes. (Excerpts from "The Experimental Determination of Strains in Aircraft Landing Wheels and Brakes," by Marvin H. Polzin. Presented at S.A.E. National Aeronautic Meeting on April 9, 1947.)

24-164. Plane Designer's Guide to 75S-T Aluminum Uses. *SAE Journal*, v. 55, June 1947, p. 59-62.
How to exploit fully the weight-saving possibilities of this alloy. Heat treatment and aging necessary to develop the maximum physical properties in 75S-T as well as its structural uses. Judicious use of 75S-T in redesigning the B-29 wing made it 16% stronger and 650 lb. lighter. (Excerpts from a paper "Use of 75S-T in Structural Applications," by George Snyder and Frank J. Crossland. Presented at S.A.E. National Aeronautic Meeting on April 9, 1947.)

24-165. How Photography Helps Production. Rupert Le Grand. *American Machinist*, v. 91, June 5, 1947, p. 101-116.
Photo layout in design and fabrication. Templets for inspection and machining. Photography speeds 3-dimensional layout. High-speed cameras probe mechanical secrets. Motion pictures need good planning. Photography in stress analysis.

24-166. Welded Machine Tools. F. Koenigsberger. *Welder*, v. 16, Jan-March 1947, p. 2-7.
Design considerations.

24-167. Gearing for Steel Mill Auxiliaries and Cranes. L. J. Collins. *Iron and Steel Engineer*, v. 24, May 1947, p. 73-79; discussion, p. 79-82.
Certain facts pertaining to the choice of pressure angles in the design of gear teeth.

24-168. Mechanism for Automatically Stopping Press When Stock Fails to Feed. F. H. Mayoh. *Machinery*, v. 53, June 1947, p. 201-202.
Blueprint shows design.

24-169. Welded Steel Construction for Large Motors. *Product Engineering*, v. 18, June 1947, p. 93.
Designed for simplicity of manufacture.

24-170. Metal Stampings in Small Lots at Reasonable Fabrication Cost. M. J. Mikulak. *Product Engineering*, v. 18, June 1947, p. 105-109.
Details of designing stampings for low-cost production with temporary or push-through dies. An example is cited showing comparative costs of an equivalent part made by different methods. Tolerances on stamped parts, assembly tolerances, and other design data.

24-171. Malleable Iron Castings. James H. Lansing. *Product Engineering*, v. 18, June 1947, p. 110-114.
Mechanical and physical properties of the standard grades of malleable iron and of pearlite and alloy malleable irons. Design data include recommended radii of fillets on ribs and sections, allowable rib and section thicknesses, and factors concerning the design of cored parts. Uses of malleable iron products.

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Welding and Cutting

(Continued from page 8)

after the advantages of welding (particularly ability to sustain damage and watertightness of welded joints) become more generally accepted so that they will outweigh the disadvantages of reconversion of design and construction equipment. The hesitancy of customers familiar with the performance of riveted ships and worried about the all-too-well publicized failures of welded ships must also be overcome.

Welded submarines (22-19, Feb. 1947), assembled from prefabricated and subassembled sections, have already proved their worth. The advantages of strong joints in heavy sections coupled with watertightness make welding the preferable, if not the only, method of assembling the much-discussed supersubmarines of the future. According to military reports (22-587, Jan. 1947), German submarines were already being welded by some of the advanced methods developed concurrently in the United States for ship construction.

Welding and cutting have been used on the railroads for 30 years, but only in the last 10 or 15 have they been used in the assembly of new equipment and on rails. The development of railroad welding to embrace the assembly of long spans of track and the construction of cars and locomotives is outlined by Grant (22-355, Sept. 1946), while flame cutting, flame hardening, and welding parts such as car axles, car wheels, and journal boxes are described by Kenefic (22-258, July 1946). Rails have been welded by seven separate processes, and about 23,000 joints have been made of which less than 2% have failed, according to Ferris (22-256, July 1946), who suggests that welded rails may solve the problem of higher maintenance costs confronting all railroads.

The greatest recent advance in the use of welding on the railroads has been in the fabrication of welded locomotive boilers. Welded boilers were prohibited by the Interstate Commerce Commission until recently—not because they were not acceptable per se (22-330, Aug. 1946; 22-233, June 1946), but because earlier experiences had been unsatisfactory if not disastrous (22-329, Aug. 1946), and until the general acceptance of the A.S.M.E. welding code for boilers, the safe operation of locomotive boilers was open to question. However, in 1936 the Delaware and Hudson Railroad obtained I.C.C. permission to construct a locomotive with a fusion welded boiler (22-328, Aug. 1946). The saving in repair costs and consequent greater availability of the locomotive for service are major favorable factors, and the I.C.C. has recently approved designs for a number of welded boilers.

Locomotive radiator headers are being welded automatically (22-238, June 1946), and it seems not unlikely that the day may come when all-welded locomotives will make their appearance. Steel railroad cars are being welded more and more, and aluminum tank cars are made of rolled 3S sheet using an automatic carbon-arc process with aluminum filler rod (22-372, Sept. 1946).

Welding is commencing to play an important part in the construction of new housing, although it is unlikely that welded houses will appear in the United States in large quantities for many years to come, because of consumer resistance to unconventional changes and the hesitancy of the building industry to adopt new tools (22-423, Oct. 1946).

That welded houses are practical is well illustrated by the actual construction of temporary welded houses in Britain (22-9, Feb. 1946) and plans for permanent prefabricated houses. The welding of a complete combination kitchen and bathroom unit for British prefabricated houses (22-59, March 1947) and well-designed American interior units which will replace many walls and at the same time permit greater utilization of floor space (22-584, Jan. 1947) suggest that the trend toward welded steel houses seems to be developing from the inside out.

24-172. Five Theories of Static Failure Explained and Compared. Charles Lipson. *Product Engineering,* v. 18, June 1947, p. 157-160.

Five theories of failure and how to select the right one. Results obtained using each theory.

24-173. Locking Fasteners. Harry Raech, Jr. *Machine Design,* v. 19, June 1947, p. 128-132, 184.

An analysis of self-locking fasteners now available for use in machine elements. Diagrams of a large number of different types.

24-174. Preferred Numbers. Reynolds Olsen Tjensvold. *Machine Design,* v. 19, June 1947, p. 133-136.

Advantages of using standard series of numbers when designing for production of a series of sizes of the same article.

For additional annotations indexed in other sections, see:
19-164-171; **20**-279; **21**-52; **22**-268-271-297-298-302; **23**-182; **27**-105.

25 MISCELLANEOUS

25-72. Handling Large Gears in Production. O. P. Adams. *Metal Progress,* v. 51, May 1947, p. 776.

Materials-handling methods used during heat treating of gears.

25-73. Institute Papers Depict Technological Trends in Steel Industry. *Steel,* v. 120, May 26, 1947, p. 114-116, 119-120, 122.

Abstracts of papers presented at meeting of American Iron and Steel Institute in New York, May 21 to 22, 1947.

25-74. An Improved Method of Removing Openhearth Slag. L. P. Lias. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.,* v. 29, 1946, p. 78-81; discussion, p. 81-84.

Mechanical method and equipment.

25-75. Maintenance of Slag Thimbles and Cars. E. H. Leathers. *Proceedings of the 29th Conference, National Open Hearth Committee of the Iron and Steel Division, A.I.M.E.,* v. 29, 1946, p. 116-118; discussion, p. 118-119.

Various types that are in use and the commonest kinds of damage to this equipment.

25-76. Material Handling in Malleable Processing. N. J. Henke. *American Foundryman,* v. 11, May 1947, p. 48-52.

The general principles of good material handling in a processing department and the economies and improvements that can be realized by their application.

25-77. Steel Warehouse Goes Modern. *Western Machinery and Steel World,* v. 38, May 1947, p. 94-97.

Plant and equipment of the Earl M. Jorgensen Co.

25-78. Western Metal Show Highlights. *Western Metals,* v. 5, May 1947, p. 34-35.

Reviews some of the technical papers presented at the exposition.

25-79. The Chemical News Parade. Tungsten Rod and Wire Production. *Chemical and Engineering News,* v. 25, May 19, 1947, p. 1442-1443.

Process followed by Sylvania Electric Products, Towanda, Pa.

25-80. Mechanical Backs Bear the Burdens. Harry S. Wharen. *American Machinist,* v. 91, May 22, 1947, p. 97-99.

Materials-handling procedures in production of Autocar trucks.

25-81. Screw Machine Engineering Data Sheet. *Screw Machine Engineering,* v. 8, May 1947, p. 63.

Weights of round, square, and hexagonal steel bars.

25-82. Twelve Ways to Handle Enameled Ware in the Spray Room. *Ceramic Industry,* v. 48, June 1947, p. 52, 54.

Conveying methods.

25-83. Grabs at Work. *Flow,* v. 2, June 1947, p. 16-18, 70.

Use of hooks and grabs of various types for miscellaneous materials-handling operations.

25-84. Liquid Nitrogen Subzero Cools Parts for Expansion Fitting. E. J. Tangerman. *American Machinist,* v. 91, June 5, 1947, p. 144-145.

Equipment and procedures.

25-85. Expansion Fits With Liquid Nitrogen. *American Machinist,* v. 91, June 5, 1947, p. 151, 153.

Linde Air Products Co. gives details of techniques and methods of calculation.

25-86. Progress in Modern Steel Works Layout. A. G. Arend. *British Steelmaker,* v. 13, May 1947, p. 250-253.

Certain South American improvements.

25-87. Water-Tube Boilers for Iron and Steel Works. *Journal of the Iron and Steel Institute,* v. 156, May 1947, p. 90-97.

Modern water-tube boiler-plant practice with special emphasis on its application to present conditions in the iron and steel industry.

25-88. Developments in the Aluminum Industry. E. G. West. *Metallurgia,* v. 36, May 1947, p. 39-43.

Alloy, process, and application developments.

25-89. Review of A.S.T.M. Research Activities. *ASTM Bulletin,* May 1947, p. 30-42.

Information on a large number of projects and the results of detailed studies.

25-90. Flat Car Conveyer System Serves 66-In. Hot Strip Mill. *Steel,* v. 120, June 16, 1947, p. 98.

Unique system in mill of Weirton Steel Co., Weirton, W. Va.

25-91. Expanded Toolsteel Facilities. R. J. Knerr and H. C. Bigge. *Steel,* v. 120, June 16, 1947, p. 110, 112, 114, 117, 132.

New equipment for controlled cooling and inspection, new cranes and rolling equipment, and other innovations at Bethlehem Steel.

For additional annotations indexed in other sections, see:
8-79.

26 STATISTICS

26-69. Report on the Copper Industry. Summary. *Federal Trade Commission,* March 11, 1947, 30 p.

Development and present status of domestic and international monopoly control in the copper industry and how the independent manufacturer of copper and brass products is thus put at a definite disadvantage in competition with the "Big Three" of the domestic copper industry.

26-70. Economics of Iron Powder Manufacture. J. F. Sachse. *Iron Age,* v. 159, May 22, 1947, p. 62-63.

Analyzes the factors that influence the economy of the iron and steel industry as compared with the iron powder industry. Existing and projected iron powder production capacity, both domestic and foreign; production figures indicate why a "good 5c powder" is not available to fabricators of iron powder products.

26-71. The Outlook in Merchant Pig Iron. Bertram S. Stephenson. *American Iron and Steel Institute Preprint,* 1947, 23 p.

Pig-iron shortage including tables of statistics.

26-72. The World Situation on Coating Materials—Lead, Zinc, and Tin. Carl A. Ilgenfritz. *American Iron and Steel Institute Preprint,* 1947, 12 p.

Raw-material resources and economic problems.

26-73. What's New in Steel? Milton Male. *Western Metals,* v. 5, May 1947, p. 18-20.

A survey of new methods, new designs, and new products in the iron and steel and allied industries, with an estimate of future trends.

26-74. World Zinc Production in 1947 Estimated at 1,636,000 Tons, Gain of 11% Over 1946. Thomas H. Miller and Richard H. Mote. *Metals,* v. 17, May 1947, p. 6-9.

Attempts to estimate the total world output of slab zinc by individual countries in 1947 and 1948.

26-75. South American Minerals in the World Economy. Pedro G. Beltran. *Metals,* v. 17, May 1947, p. 11-12.

Former ambassador from Peru to the United States discusses the effects of tariff policies.

26-76. Substitutions for Brass Deemed Temporary; Present Production Above 1940, Below 1941. H. A. Schilder. *Metals,* v. 17, May 1947, p. 13, 17.

Users expected to revert to brass when reasonable delivery is assured.

26-77. Suspension of Four-Cent Import Duty on Copper by U. S. Likely to Influence World Markets. L. H. Tarring. *Metals,* v. 17, May 1947, p. 16-17.

Effect especially on Great Britain.

26-78. Rolled Zinc Production in United States During Current Year Expected to Decline. H. D. Carus. *Metals,* v. 17, May 1947, p. 18.

Future prospects.

26-79. Average Analyses of 1946 Shipments of Lake Superior Iron Ore. *Skillings' Mining Review,* v. 36, May 31, 1947, p. 1, 13.

Analyses for the different types and production areas.

26-80. The Future of the Steel Industry. Wilfred Sykes. *Blast Furnace and Steel Plant,* v. 35, June 1947, p. 695-701.

Trends. (Read at general meeting of American Iron and Steel Institute, New York, May 21, 1947.)

26-81. Iron and Steel in the Philadelphia District. T. J. Ess. *Iron and Steel Engineer,* v. 24, May 1947, p. 18S-30S.

Illustrated article contains much statistical data.

For additional annotations indexed in other sections, see:
14-146; **23**-183; **27**-112-115.

27 NEW BOOKS

27-105. Mechanics of Materials. Edition 2. Philip Gustave Laurson and William Junkin Cox. 422 p. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $4.00.

In this new edition of a textbook first published in 1938, a chapter on columns with axial loads replaces the former one on column theory, and a chapter on columns with eccentric loads replaces the one on design of columns. Mohr's circle is added to the discussion of combined stresses. There are 640 problems. Tables appended are sufficient for solution of all prob-

(Turn to page 50)

Precision Casting Description Deals With High-Temperature Alloys

Reported by F. G. Wayman

Chemist, The Steel Co. of Canada, Ltd.

Dealing mainly with the high-temperature alloys comprising the cobalt, tungsten, nickel and chromium groups, C. R. Whittemore, research metallurgist, Deloro Smelting & Refining Co., Ltd., presented an interesting address on "Precision Castings" before the Montreal Chapter on April 7. Processing equipment and industrial precision-cast machine parts were illustrated by slides.

The so-called "lost wax" process forms the basis for the production of small (3 lb. to ½ oz.) industrial castings of intricate shape, smooth surface and tolerances of 0.003 to 0.005 in.

The first step in the process is to make a master pattern of steel, brass or aluminum to dimensions which compensate for shrinkage of wax and metal. To prepare the mold the pattern is placed in a steel flask and supported with plasticene. "Rapid Stone" or its equivalent is poured around the pattern, the plasticene removed, and the pattern and Rapid Stone are coated with colloidal graphite. A low melting point alloy such as "Cerrosafe" is cast against the prepared pattern and allowed to cool; the Rapid Stone is then removed, graphite applied to the surface of the pattern and mold, and the other half cast in a similar manner.

Wax is injected into this mold under pressure of 20 to 100 psi. Proper venting prevents the formation of air bubbles. Wax temperature is controlled within ±5° C.

The wax pattern is then brushed or dipped in a refractory slurry containing —325 mesh material; this gives smoothness and detail to the casting. The assembly of pattern and feeders is then placed in a steel ring and a coarser refractory poured around it. After the ceramic sets the wax is melted out at only a few degrees above its melting point. After all wax has been removed the molds are preheated to 1500 to 1850° F. depending upon requirements of the alloy to be cast.

The metal may be cast by centrifugal or pressure methods. Temperature must be closely controlled. After cooling for 5 to 8 hr., the ceramic material is knocked away and the casting sandblasted. If further finish is required, the casting may be machined, ground or buffed.

Precision casting problems are somewhat similar to those met in regular foundry practice. Gating and venting of the mold, cooling rates, metal control and deoxidation are all important factors to be considered.

Two films "High Speed Motion Photography" and "Wings of Wire" presented through the courtesy of the Northern Electric Co., Ltd., preceded Mr. Whittemore's address. Chairman S. B. McRobert presided and, on behalf of the chapter, Prof. Gordon Sproule extended a hearty vote of thanks to the speaker.

Talks on Process Control

Reported by Glenn E. Pelton

Metallurgical Department
Willys-Overland Motors, Inc.

A return visit was paid the Detroit Chapter by the Toledo Group on May 12, on the occasion of a joint meeting of the two units. An address given by C. L. Stevens of the Ford Motor Co. stressed the importance of his topic, namely, "Metallurgical Process Control", in modern mass production methods.

Standardization of various manufacturing methods, control of materials, periodic checks to see that specified practices are maintained, and the method used by Ford Motor Co. were among the many items emphasized by Mr. Stevens. The meeting closed with a lengthy question-and-answer period.

20 Testing Articles Ready for Handbook

Five of the nation's leaders in the field of mechanical testing, members of the Committee on Mechanical Testing of the American Society for Metals, have completed the correlation of a group of articles for publication in the 1947 Metals Handbook. This year's Handbook, soon to be published, will be the first since the 1939 edition.

The Mechanical Testing Committee consists of A. O. Schaefer, Midvale Co., chairman; Maxwell Gensamer, Pennsylvania State College; Howard Scott, Westinghouse Electric Corp.; R. L. Templin, Aluminum Co. of America; and E. C. Wright, National Tube Co.

Twenty articles have been prepared by various authors for the committee. Three introductory articles give a general treatment of the subject of mechanical testing; nine articles describe specific tests such as tension, hardness, bend, and others; and eight articles describe the application of various tests to particular products such as sheet metal, tube, welds, castings, forgings and wire.

Information contained in the mechanical testing section is descriptive in nature. Reference, however, is made to various standard methods of testing as published by the several authoritative bodies in this field.

lems in the text. (From review in *Aeronautical Engineering Review*, v. 6, April 1947.)

27-106. Resistance of Materials. Edition 3. Fred B. Seely. 486 p. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $4.00.

Engineering problems in general; emphasis on any particular field is avoided. Developments in use of light metals and high-strength metals such as alloy steels. Welded connections.

27-107. A Century of Silver. Earl Chapin May. 400 p. Robt. M. McBride & Co., 200 East 37th St., New York 16, N. Y. $3.50.

The evolution of silverware in mass production from early plated products made at home by crude processes, through britannia ware and finally into plated and sterling ware produced by modern methods. This story of silver is set against the background of the rise and development of the International Silver Co.

27-108. Brass Pressings and Other Copper Alloy Products. 72 p. Copper Development Association, Grand Buildings, Trafalgar Square, London, W.C. 2, England.

A general description of the principal processes employed in the manufacture of copper alloy strip and sheet products and the mechanical properties and chemical compositions of the commercial copper alloys, brasses, and bronzes.

27-109. Essays on Rheology. 103 p. Sir Isaac Pitman and Sons, Ltd., Parker St., Kingsway, London, W.C. 2, England. 12s. 6d. net.

The rheology of metals, polymers, and liquids. The rheology of polymers and liquids. The plasticity of metals. The relationship between compression and shear tests. The time-variations of stress and strain. Rheological nomenclature and symbols. The applications of rheology to medical science. Rheology and naval problems. Rheology in the fine arts.

27-110. Casting Alcoa Alloys. 140 p. Aluminum Co. of America, 2140 Gulf Bldg., Pittsburgh, Pa.

Properties and applications of the various aluminum-ingot products and casting alloys made by Alcoa. Recommended foundry practices and heat treatment procedures.

27-111. Proceedings of the Twenty-Ninth Conference—National Open Hearth Committee of the Iron and Steel Division. Volume 29. 341 p. 1946. National Open Hearth Committee, Iron and Steel Division, A.I.M.E., 29 West 39th Street, New York, N. Y.

Technical papers and discussion at basic and acid-openhearth sessions of Chicago meeting, April 24-26, 1946.

27-112. Year Book of the American Bureau of Metal Statistics. Twenty-Sixth Annual Issue. 112 p. American Bureau of Metal Statistics, 33 Rector St., New York, N. Y.

An annual statistical compilation covering production, consumption, prices, imports, and exports, not only for U. S. but for the rest of the world as well. Divided into the following main sections: copper, lead, zinc, gold and silver, and miscellaneous.

27-113. Symposium on the Hardenability of Steel. 430 p. Iron and Steel Institute, 4 Grosvenor Gardens, London, England. (Special Report No. 36.)

The Hardenability Sub-Committee of the British Iron and Steel Institute was formed following a visit of British metallurgists to the U. S. in 1943 to discuss the conservation of critical alloys in steel production. The purposes of the committee were: to standardize the conditions of carrying out the end-quench (Jominy) hardenability test, examine the effect of deviation from the standard conditions, and adopt a standard method of reporting the data; to examine the fundamental principles governing the test and recommend the best methods of interpreting the results; and to survey a representative set of steels by hardenability tests and correlate the results with mechanical properties. Details of the resulting extensive investigation, the results obtained and suggestions for future research. A bibliography of 255 references covers the years 1938 through 1944.

27-114. 60 Years With Men and Machines. Fred H. Colvin. 300 p. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. $3.50.

This book was written by a man who has spent some 63 years in or connected with the metal-manufacturing industry. It is an absorbing, and sometimes highly amusing, account of the world of invention, machinery, and production from 1884 to the present day. (From review in *Modern Machine Shop*, v. 20, June 1947.)

27-115. Strategic Minerals. John B. DeMille. 626 p. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. $7.50.

Detailed information on the essential chemical and physical properties of 76 strategic metals and minerals. Sources of these materials, and pertinent statistics on the domestic and foreign output and distribution of each. The development of new applications for these minerals in industry, and new methods in metallurgy. Brief review of government regulations affecting procurement and production, and a detailed discussion of stockpile directives.

27-116. Running a Machine Shop. Edition 2. Fred H. Colvin and Frank A. Stanley. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. $4.00.

Advances, new methods, standards, use of color, color codes in the shop, machining of Dowmetal and magnesium, glass-reinforced plastics, windowless shops, and use of broaching instead of milling in the making of rifle parts.

MATERIALS INDEX

The following tabulation classifies the articles annotated in the A.S.M. Review of Current Metal Literature according to the metal or alloy concerned. The articles are designated by section and number. The section number appears in bold face type and the number of the article in light face.

Kempf Dies, Was Alcoa Asst. Research Director

Louis Walter Kempf, assistant director of research for Aluminum Research Laboratories, died in Cleveland, June 14, after an extended illness. Mr. Kempf, who had achieved international recognition as a scientist, author, and inventor during the 23 years he was associated with Aluminum Co. of America, had been on leave from his Alcoa post since undergoing an operation last August.

L. W. Kempf

Long active in the American Society for Metals, Mr. Kempf served as chairman of the Publications Committee in 1938-40, and—as a member of the Metals Handbook Committee—planned the section on aluminum for the forthcoming 1947 edition. In 1946 he was elected chairman of the A.I.M.E.'s Institute of Metals Division, and also had been named annual lecturer for the division for 1948—an honor which illness forced him to decline.

Mr. Kempf was born in Luther, Mich., in 1898, and after serving overseas in World War I, entered the University of Michigan, where he earned both B.S. and M.S. degrees. In 1924 he became associated with Alcoa as a research metallurgist, successively having charge of the Cleveland metallurgical division, becoming manager of the Cleveland branch of the Laboratories, and in 1945 assistant director of research.

Foundry Program Established

A national educational program to encourage foundry training has been established under the direction of a Foundry Educational Foundation, sponsored jointly by the Gray Iron Founders' Society, the American Foundrymen's Association and the Foundry Equipment Manufacturers' Association. Objectives of the plan are to arrange basic courses of study in five engineering colleges, to sponsor scholarships, to help purchase foundry equipment for these colleges, and to support the program with a fund of $280,000 contributed by industry members.

The present program will finance 50 scholarships to be granted to students during the next three years.

Opens Consulting Service

William B. Brooks announces the establishment of a metallurgical consulting service in Pittsburgh. He studied metallurgy at the Colorado School of Mines, and has served as assistant plant metallurgist, Allegheny Steel Corp.; metallurgist, stainless steel division, Carnegie-Illinois Steel Corp.; materials and welding engineer, Cramp Shipbuilding Co.; and, more recently, was associated with the Alloys Development Co. Mr. Brooks has broad technical and industrial contacts in the steel and fabricating industries.

EMPLOYMENT SERVICE BUREAU

The Employment Service Bureau is operated as a service to members of the American Society for Metals and no charge is made for advertising insertions. The "Positions Wanted" column, however, is restricted to members in good standing of the A.S.M. Ads are limited to 50 words and only one insertion of any one ad will be printed. Address answers care of A.S.M., 7301 Euclid Ave., Cleveland 3, Ohio, unless otherwise stated.

POSITIONS OPEN

SALES REPRESENTATIVES: To handle nationally famous electric heat treating furnace line. Straight commission basis. St. Louis and Pittsburgh territories. Box 7-5.

PETROGRAPHER: For private firm working on long-term governmental research contract, to investigate behavior of ceramics and metallic compounds at high temperature. Principal qualification, beyond technical competence, is boldness in the sense of being unafraid to tackle intricate problems by unconventional methods. The right man will enjoy excellent cooperation of specialists in related fields and have at his disposal adequate instrumental equipment. Box 7-75.

METALLURGIST: Wanted by manufacturer of oil field equipment for Texas plant. Must be well founded in metallurgy with ability and desire to do field work involving travel in mid-continent area as well as plant duties. Box 7-80.

POSITIONS WANTED

METALLURGIST: Age 32. 5 yr. exp. in ferrous, nonferrous and special alloys. Some grad. work. Familiar with Government aeronautical specifications. Desires position with mfg. firm. No preference as to location. Box 7-10.

MECHANICAL ENGINEER: Age 28. B.A., B.M.E., M.M.E. 3 yr. experimental and development work in metallurgy and related mechanical processes (machinability, internal stresses, carburization). 1 yr. college teaching. Desires position doing development work with progressive co. Box 7-15.

CHEMIST-METALLURGIST: 9 yr. exp. in chemical analysis of ferrous and nonferrous metals and spectrographic analysis of brass, aluminum and white metal alloys. Has been in charge of production quality and control in nonferrous metal plant. Age 32, married. B.S. in chem. Box 7-20.

PHYSICAL METALLURGIST: Age 27, married. M.S. and D.E. in met.; recent grad. Familiar with physical met. of light metal alloys, X-ray diffraction, radiography and metallography. Exp. as teaching asst. Desires research work in nonferrous and ferrous met. or teaching position with research facilities. Location immaterial. Box 7-25.

METALLURGIST—PLANT MANAGER: Age 37. Nonferrous ingot production. Successful executive with 10 yr. exp. increasing production, reducing costs and negotiating satisfactory contracts with difficult union groups. Top-flight organizer, able to integrate all plant departments into winning team with high morale. Box 7-30.

Civil Service Metallurgists

Examinations for positions as metallurgists in Washington, D. C., and in Virginia and Maryland have been announced by the Civil Service Commission. Salary brackets are from $7102 to $9975 and from $3397 to $5905 per year. Applicants must have appropriate education and experience in the field of metallurgy. For higher salaries, applicants must have achieved recognition of their work. Applications may be secured at post offices, from Civil Service regional offices, or from the U. S. Civil Service Commission, Washington 25, D. C. July 22, 1947, is the last day on which they may be filed for positions in the $3397 to $5905 range. Those for higher salary levels will be accepted until further notice.

HEAT TREAT SUPERINTENDENT: Young, aggressive. 11 yr. exp. all alloys and all methods. Tool forging and treating a specialty. Willing to relocate for position with good present and better future. Prefers dry climate. Box 7-35.

SALES ENGINEER: M.E., Ph.D. Executive type. 10 yr. mechanical-metallurgical diversified industrial sales exp. All-around shop exp. Age 35, married. Wishes to connect with progressive manufacturer. Free to travel; headquarters New York City. Box 7-40.

TRADE POSSIBILITIES IN CHINA: If you are interested in finding out about the possibility of a market for your products in China, A.S.M member has recently returned from an assignment there under UNRRA and is qualified to give information about sales possibilities, engineering needs and the ability of the country to purchase American-made goods. Box 7-45.

PRODUCTION ASSISTANT: Mechanical engineer. 15 yr. exp. production and material control medium and heavy industry. Some sales exp. and knowledge of met. Broad exp. planning, scheduling stores and purchasing requirements. Prefers East Coast. Adaptable and reliable; has ideas or can plan and carry out yours. Used to getting things done. Box 7-50.

METALLURGIST: Age 30, married. B.S. Exp. as lab. asst. instructor in chem. Chemical lab. asst. in industry, draftsman and time study, metallurgical lab. asst., engineer officer U.S. Navy, foreman in tooling and tool performance problems. Location immaterial. Available in Sept. Box 7-55

METALLURGICAL ENGINEER: Age 26, single. B.S. in met. eng. Michigan College of Mining & Technology. 1 yr. exp. in automotive field. 4 yr. officer Army Air Corps. 1 yr. shift superintendent nonferrous smelter and refiner. Interested in position with opportunity for advancement. Sales considered Prefers Michigan area. Box 7-60.

HEAT TREAT FOREMAN: 12 yr. exp. in heat treating of tools, dies and production work. 10 yr. exp. in toolsteel mills in charge of inspection and heat treating. Would like position in New Jersey or the New York metropolitan area. Box 7-65.

METALLURGIST: With either industry or government. Age 32, married. Exp. in chem. and met. testing of pure metals, alloys, ores, concentrates and inorganic substances. Metals specification writings; corrosion problems. Box 7-70.

PRODUCTION AND EXECUTIVE ENGINEER: With long exp. in the development of new products, interdepartmental coordination, improvement of manufacturing methods and sales research. Background principally in heavy machinery and copper and brass industry. Salary in relation to responsibilities and location. Box 7-85.

PRODUCT ENGINEER AND DESIGNER: Grad. mech. eng. 17 yr. technical education with 16 yr. exp. in engineering, design, research, drafting supervision, quality control and production manufacturing. Desires responsible supervisory position with progressive established firm. Now located in east, but willing to move. Box 7-90.

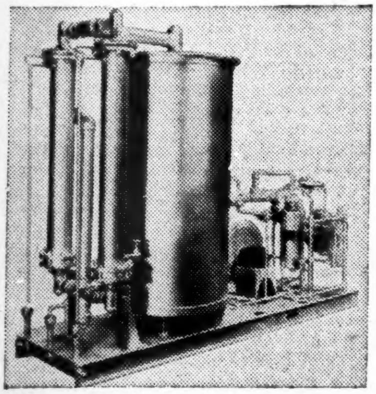
METALLURGICAL ENGINEER: Supervisory training, degree and 10 yr. exp. in met. and eng. Exp. in steelmaking, metallography, carburizing, machinability, heat treating of nonferrous alloys, technical writing, complaint investigations and contact work. Desires position as chief metallurgist or specialized sales engineer. Well qualified in theory and exp. Present salary $5500. Age 35. Box 7-95

NEW PRODUCTS IN REVIEW

ATMOSPHERE PRODUCER

The Vapofier gas generating unit, which is now serving in some 85 types of industrial heat applications, has recently been selected as a means of firing atmosphere producers used in connection with electric furnaces.

The Vapofier, utilizing fuel oil, generates Vap-O-Gas, which is burned in the combustion chamber of the atmosphere producing equipment. The products of combustion are then taken through condensers which remove the water vapor and the resulting atmosphere is delivered to the furnace or oven under any desired pressure. Fuel-air ratio may be predetermined and maintained throughout the entire range of capacity of the Vapofier, without change in the manifold pressure—a most desirable feature of the Vapofier for atmosphere producing purposes.



The flame quality may be varied widely from oxidizing to reducing and once the proper analysis of products of combustion is determined, the unit may be set so that it will produce the same results constantly. Through the built-in diaphragm control system the Vapofier instantly and automatically adjusts to any variance in requirement without change in flame quality or manifold pressure.

The accompanying illustration shows the Vapofier attached to atmosphere producing equipment developed and used by Hevi Duty Electric Co. of Milwaukee.

THE VAPOFIER CORP.,
10316 South Throop St.,
Chicago 43, Ill.

Mention R-726 for Reader Service

CASTINGS, COPPER

Non Ferrous Foundries, Inc., has installed facilities and perfected manufacturing techniques for the production of special heat treatable copper alloy castings made under a license arrangement with P. R. Mallory Co., Inc. The line includes copper castings ranging from 20 to 85% I.A.C.S. electrical conductivity, hardness values ranging from Rockwell B-65 to C-38 and tensile strength from 50,000 to 110,000 psi.

The new materials provide unusual combinations of physical and electrical properties. They are particularly useful for electrical and resistance welding applications and industrial fields where high strength, wear resistance, thermal conductivity, high elastic properties and high creep strength are desirable.

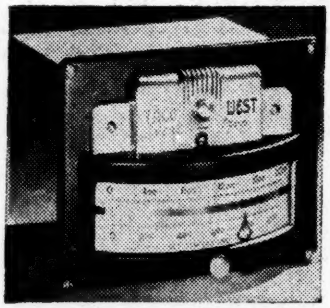
NON FERROUS FOUNDRIES, INC.,
22nd and Sherman Dr.,
Indianapolis 1, Ind.

Mention R-727 for Reader Service

CONTROLLER, PYROMETRIC

The new Veritron electronic pyrometric controller offers many unique features including a new electronic circuit, ultra compact design and simplified operation. It is specially suited for direct installation on industrial furnaces and plastic molding machines.

In operation, the control pointer is set at the desired temperature and control is immediately established within a narrow temperature range. The instrument movement operates a heavy duty relay system without any physical contact or reaction effect on the indicating pointer. The relay is built in and has a load capacity of 3 kw. non-inductive. The electronic circuit requires no tuning or other adjustment by the user at any time. This is accomplished without using high-frequency oscillator systems, capacitance systems or mechanical clamping mechanisms.



The electronic control mechanism is stable (chatter-free relay operation) and unaffected by line voltage variation, surge effects, tube aging or component changes.

Measuring system and electronic mechanism are separately housed in sealed units that plug into the instrument case. The complete instrument measures only 7⅛ by 5¾ by 5¼ in. and may be either flush or surface mounted.

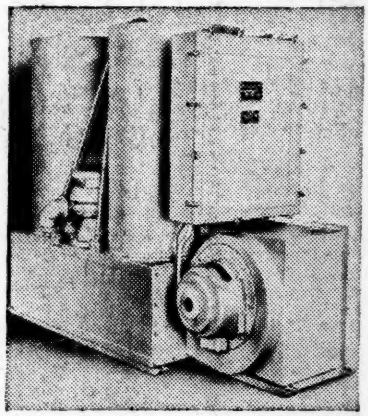
TACO WEST CORP.,
2620 South Park Ave.,
Chicago, Ill.

Mention R-728 for Reader Service

DEHUMIDIFICATION MACHINES

The improved and war-developed dehumidification machines which made possible the major portion of the Navy's fleet preservation program, popularly known as "Operation Zipper," are now available to private industrial and commercial users.

Although prewar Lectrodryer equipment found its widest use in the metallurgical, chemical, oil and gas industries, its successful use by the Navy in the preservation of a ship and its machinery has opened new and potentially greater markets.



The problem in the Navy was how to prevent airborne moisture and atmospheric conditions from causing the corrosion of metals and general deterioration of materials. Atmosphere within the vessels had to be maintained at a relative humidity of 30% or less under the entire range of weather and operating conditions throughout the year in any of the 14 berthing areas scattered throughout the continental United States.

Lectrodryer dehumidification machines remove moisture and gases from the air by the physical phenomenon known as solid adsorption; in other words, a distinct affinity exists between certain types of surfaces and the molecules of certain gases which causes the gases to attach themselves to the surface of the solid. Actually, in effect, the gas is condensed to a liquid and in so condensing latent heat is given off. The application of heat to the solid will cause a release of the adsorbed liquid. This application of heat is known as reactivation and is the basic principle through which Lectrodryer equipment offers complete, continuous drying in one self-contained machine.

PITTSBURGH LECTRODRYER CORP.,
Ft. of 32nd St.,
Pittsburgh 30, Pa.

Mention R-729 for Reader Service

NEW PRODUCTS IN REVIEW

FURNACE, ELECTRIC

A new electric furnace known as model GTP features a new type of stepless heat control. Furnace temperature can be raised or lowered simply by moving a control knob to right or left. Any desired temperature between 500 and 1850° F. can be selected and automatically maintained. This Temco control is nearly 100% compensating for normal fluctuations in line voltage, and is available for use on direct current as well as alternating current of any cycle.

Model GTP has inside dimensions of 4 in. wide, 3¾ in. high and 3¾ in. deep. It is equipped with a dependable indicating pyrometer calibrated in both fahrenheit and centigrade scales.

The heating element is coiled from heavy-gage alloy, and is embedded in the sides, top and bottom of the heating chamber. The body and door are one-piece aluminum castings which make the unit light in weight—only 15½ lb.—and therefore easily portable.

THERMO ELECTRIC MFG. CO.,
474 West Locust St.,
Dubuque, Iowa.
Mention R-730 for Reader Service

FURNACE, LABORATORY

A new medium-size laboratory furnace, termed the Model 9A De Luxe, with built-in automatic temperature controls, has over-all dimensions of 19 x 20½ x 21¼ in. The furnace maintains any desired temperature automatically between 250 and 1900° F., and reaches a maximum 2000°.

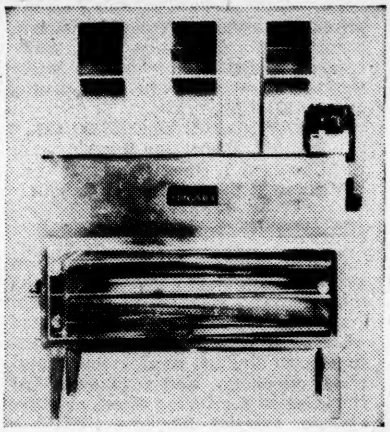
The heating unit consumes 2000 watts at 110 volts (a.c. only) and is constructed of heavy-gage special alloy wire. The furnace itself is made of heavy-gage steel, with multi-layered insulation. Inside dimensions are 6 x 6 x 6 in., with a 3¼ in. throat additional. The complete Huppert Model 9A De Luxe, including automatic heat controls, weighs 148 lb.

K. H. HUPPERT CO.,
6830 Cottage Grove Ave.,
Chicago 37, Ill.
Mention R-731 for Reader Service

HEATER, STEAM

The Niagara high-pressure system fan heater for heating large spaces uses a dual-coil system to obtain complete utilization of both the latent and sensible heat of high pressure steam. It eliminates the necessity for complex secondary piping, reducing stations and accessories. This coil system is installed in a fan heater of standard design in which air is drawn through the heater by centrifugal fans.

The high-pressure steam is condensed in a finned coil, the condensate flowing into a trap from which it is admitted to the regenerative vapor coil



entering the header where it flashes into vapor. Any of the high pressure condensate remaining liquid at this point is drained directly to the final condensate return header by a hairpin bend tube from which this condensate gives off its heat into the air stream.

The vapor condensing coil has its top (or vapor) leg finned and steeply pitched. The lower (or condensate return) leg is relatively flat, leading to the condensate return header in which there is a weir that keeps the liquid level high in this leg where it is in contact with the coldest portion of the air stream. This subcools the condensate below its relative return temperature. The weir has a bleed hole for draining the condensate upon shutdown.

From the vapor coil condensate return header the condensate is withdrawn into the return system to the boiler. Vacuum return is vapor-free and fully efficient, returning the condensate evenly and without flashing, at low pressure and temperature.

NIAGARA BLOWER CO.,
405 Lexington Ave.,
New York 17, N. Y.
Mention R-732 for Reader Service

WELDERS, FLASH

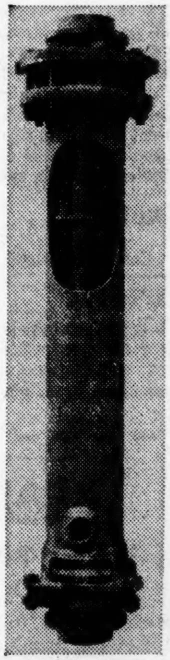
A technical bulletin (No. 204) describes this company's improved line of motor-operated flash welders. Construction of these machines combines both universal and specially engineered features and is designed to provide versatility of operation over a wide range of applications.

Convenience of operation and setup and outstanding performance characteristics are features of these flash welding machines. The entire machine control is from one position, and all settings such as those for flashing voltage, amount of upset, and platen travel speed can be made within a few minutes.

The bulletin lists four basic sizes having ratings at 50% duty cycle of 20, 50, 100, and 150 kva. and upset forces of 2250 lb., 4500, 11,500, and 19,600 lb. respectively. The machines are also available as storage battery operated units. The bulletin carries complete specifications, photographs of machines and detailed closeups.

PROGRESSIVE WELDER CO.,
3050 E. Outer Dr.,
Detroit 12, Mich.
Mention R-733 for Reader Service

HEAT EXCHANGER



Seven-tube "Karbate" impervious graphite shell and tube heat exchangers for use under highly corrosive conditions are now available in three standard sizes, namely, 4 ft. 3 in., 7 ft. 3 in., and 10 ft. 3 in. in length. All three units employ 1 x 1½-in. Karbate tubes in bundles encased in standard 6-in. steel pipe shells. The exchangers are identical in every respect except for pipe length and the number of Karbate baffles, and all tube bundles and shells of the same size are interchangeable.

The units can be employed as heaters, coolers, boilers or condensers, and can be operated vertically or horizontally. They will carry temperatures up to 338° F. and a working pressure of 50 psi. on both the tube and shell sides. Standard nozzle connections permit ready installation with piping connections of almost any material of construction. Water, brine or steam are suitable on the shell side.

Karbate impervious graphite has the well-known properties of high thermal conductivity (three times as high as carbon steel) and resistance to the action of most acids, alkalis, and other corrosive, solvent or reducing agents—particularly to all concentrations of hydrochloric acid and nearly all concentrations of hot sulphuric, phosphoric, and acetic acids, wet chlorine and the organic solvents. A unique feature of construction is the combination of tube sheet, dome and nozzle into one piece, which eliminates packed joints for the corrosive liquid and reduces the number of gasketed joints on the fluid side to one gasket at each nozzle.

NATIONAL CARBON CO., INC.,
New York City.
Mention R-734 for Reader Service

NEW PRODUCTS IN REVIEW

HEAT EXCHANGER

The Durco No. 4 heat exchanger is a highly efficient unit for heating or cooling corrosive solutions over a wide range of temperatures. It is supplied both as a heater and a cooler. The 4H heater is arranged for heating by steam, the 4C cooler for cooling by means of water or other non-corrosive solutions. The inner tube and baffle core are made of duriron. The outer jacket is steel. Both heater and cooler can be supplied with either split flanged or hose connections.

The duriron baffle core is made in four sections which fit together with centering tongue and groove to form a continuous spiral for the corrosive solution. This spiral channel directs the flow of the liquor in a long, agitated contact with the duriron tube wall, through which excellent heat transfer is obtained. In the cooler, a spiral is also used for the water or liquor in the outer jacket.

DURIRON CO., INC.,
Dayton 1, Ohio.

Mention R-735 for Reader Service

ELECTRIC EQUIPMENT

A new catalog of electric equipment for maintenance, safety and production contains 60 pages of well-illustrated data and tabulations of sizes, types and prices. It covers production equipment, commutator maintenance, motor maintenance, electrical maintenance, safety equipment, mechanical maintenance, and metalworking saws.

MARTINDALE ELECTRIC CO.,
Box 617, Edgewater Branch,
Cleveland 7, Ohio.

Mention R-736 for Reader Service

GRINDING WHEEL PRICES

A new quantity pricing system on grinding wheels has been adopted by this company, identical to the system employed for many years on mounted wheels. It incorporates many advantages over the old, cumbersome schedule of discounts. Now anyone can find the price on a grinding wheel, or other Chicago abrasive products, without a great deal of calculation and the need of a slide rule. A copy of this new schedule will be sent on request.

CHICAGO WHEEL & MFG. CO.,
1101 West Monroe St.,
Chicago 7, Ill.

Mention R-737 for Reader Service

INSTRUMENTS, COMBUSTION

A new line of combustion testing instruments includes portable and stationary transparent CO_2 indicators, draft gages, manometers and accessories. Outstanding among the newly designed instruments are the Model 800 transparent CO_2 indicator and the Model 100 draft gage, both of which are portable, and offered with various accessories as needed by the individual operator.

The transparent CO_2 indicator gives good visibility, accuracy, and simplicity of design such that even an inexperienced operator can make accurate tests with little or no training. The instrument's body consists of a solid block of strong, clear plastic which remains permanently unaffected by the bright red indicating solution. Since no glass is used, and all metal parts are of stainless steel, the instrument is said to be virtually unbreakable.

The portable draft gage, also of transparent plastic, measures all types of air velocities, drafts, and slight pressure changes. Light is admitted from all sides, leaving every part completely visible. Scale graduations extend a full 5 in., with more than an inch of sliding adjustment. Draft indication is continuous and all fluctuations may be observed while adjustments are made.

F. W. DWYER MANUFACTURING CO.,
317 South Western Ave.,
Chicago 12, Ill.

Mention R-738 for Reader Service

READER SERVICE COUPON

CHECK THESE NUMBERS FOR PRODUCTION INFORMATION AND MANUFACTURERS' CATALOGS

Use this convenient method to obtain further information on items of interest to you in METALS REVIEW. The following numbers refer to the new products and manufacturers' literature in this issue.

THIS COUPON IS VOID AFTER OCTOBER 1, 1947

Metals Review, July 1947

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R-685	R-695	R-705	R-715	R-725	R-735	

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MAIL TO METALS REVIEW, 7301 EUCLID AVE., CLEVELAND 3, OHIO

NEW PRODUCTS IN REVIEW

INDICATOR

Where a large number of thermocouple temperatures must be logged in a short time, the Speedomax indicator provides a good answer to the problem. To read a temperature, the operator merely flips a key switch marked for the desired thermocouple; the instrument's drum scale spins, to stop quickly and surely at the correct temperature. When logging temperatures, the limiting factor is the speed with which the operator can write down his readings. In addition to speed, the indicator has high sensitivity and accuracy, even for low temperatures and short ranges. Wide markings make its scale exceptionally easy to read.

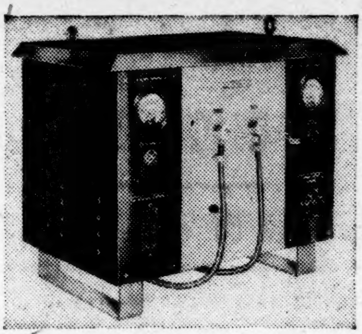
Switching arrangements can be supplied to meet the needs of practically any application. A single instrument easily handles more than 100 thermocouples. Key switches can be color-coded for convenience in identifying points. Heat of the indicator's high-speed balancing mechanism is a Speedomax amplifier unit, which uses standard, easily bought vacuum tubes. All the more commonly used ranges for industrial thermocouples can be supplied.

LEEDS & NORTHRUP CO.,
4934 Stenton Ave.,
Philadelphia 44, Pa.

Mention R-739 for Reader Service

INDUCTION HEATER

A new 2-kw. bench model induction heating unit is the smallest unit in dimensions ever made by the company. This handy yet efficient machine is a



great space saver and can be used on a shop bench. It is only 22 in. wide, 20 in. high (overall) and 16 in. deep.

The unit is simple to use. It operates from a 110-volt line. It comes complete with foot switch and one work coil made to customers' requirements. This work coil can be from ½ to 2½ in. in diameter, and the unit will operate with a coil of one turn to a maximum of 20 turns.

SCIENTIFIC ELECTRIC DIV.,
"S" Corrugated Quenched Gap Co.,
Garfield, N. J.

Mention R-740 for Reader Service

REFRACTORIES

Four-page folder lists four necessary characteristics for good refractory linings or muffles as *(a)* deformation point well above the operating temperatures of the furnaces; *(b)* high resistance to thermal shock; *(c)* high thermal conductivity; and *(d)* good dielectric strength.

These four necessary characteristics have been built into two distinct types of refractories made by the company —namely, the "A" refractories (crystalline alumina), and the "C" refractories (silicon carbide).

BAY STATE ABRASIVE PRODUCTS CO.,
Westboro, Mass.

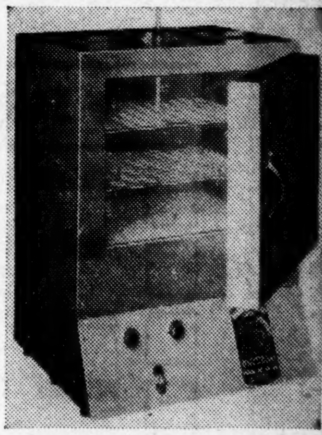
Mention R-741 for Reader Service

OVEN, LABORATORY

The KH 1200, a new electric laboratory oven, features equalized heat by means of a simple double-venting device. Equalization of oven heat is regarded as a major advance in laboratory oven design, since simultaneously varying temperatures within the oven tend toward inaccurate test results.

The automatic hydraulic-electric temperature control featured in this new furnace is said to be very sensitive. Temperature is controlled to an accuracy of ± 1° C. at any desired point within the furnace range to 420° F. (220° C.).

The KH 1200 presents a modern simplicity of design, and is well insulated with 1⅝ in. of thermo-block throughout for maximum heat retention. It is particularly adapted to general chemical and analytical work, and for heating, drying, baking, and testing. It has a stainless steel interior 12x10x10 in.; outside dimensions are 15⅝x21¼x15 in. It is equipped with two adjustable



vents having stainless steel slides to control exhausted air and equalize temperature inside the oven.

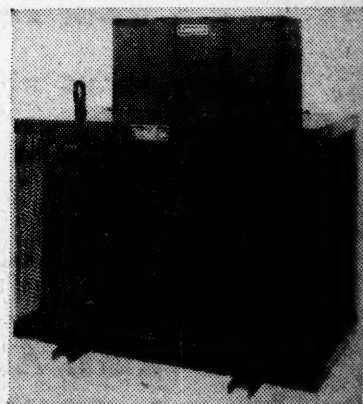
K. H. HUPPERT CO.,
6830 Cottage Grove Ave.,
Chicago, Ill.

Mention R-742 for Reader Service

TRANSFORMERS

This company is now manufacturing a complete line of air-cooled transformers for use with electric furnaces, for testing functions, and various applications requiring heavy current.

The Lindberg line of transformers features a built-in wiring compartment



and terminal board, engineered to facilitate ease of installation. Tap switches to handle up to 500 amp. are available for all transformers. Sizes obtainable are rated from 1 to 100 kva., up to 600 volts, single-phase, 3-phase, or 3 to 2-phase.

LINDBERG ENGINEERING CO.,
Transformer Division,
2444 W. Hubbard St.,
Chicago 12, Ill.

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Brief description and application of all Holden Baths.

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Technical information and data on Du Pont descaling process.

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Technical information for Martempering and Isothermal Heat Treating.

☐ **MH-401** HOLDEN MARQUENCHING FURNACE—5 pages.
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Chemical control for carburizing and neutral hardening baths.

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You are invited to make full use of our Research Laboratory in solving your Heat Treating Problems.

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